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ABSTRACT

The National Center for Research in Vocational Education (NCRVE) was consulted to improve the formative evaluation design for the Principles of Technology (PT) curriculum materials developed by the Center for Occupational Research and Development (CORD) and the Agency for Instructional Technology (AIT). Because the NCRVE entered the formative evaluation effort at midpoint in its evaluation time line, the formative evaluation activities being conducted by the curriculum developers were reviewed and minor changes were suggested. It was recommended that (1) case studies be used to provide the curriculum developers with a greater depth of information about the setting in which local schools were attempting to implement PT, (2) future formative evaluation efforts should be designed concurrently with the development of the curriculum and the development of strategies for field testing it, (3) the purpose and nature of formative evaluation should be thoroughly explained to all concerned parties, and (4) extensive communication should be maintained between curriculum developers and users. (Appendixes to this report include a membership list of the content review team, the first-year evaluation instruments, the formative evaluation time line, the approach for the second-year formative evaluation time line, the approach for the second-year formative evaluation that has been suggested by the NCRVE, the second-year instruments used by CORD and AIT, and an interview assessment guide.) (MN)

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A DESIGN AND ASSESSMENT OF A FORMATIVE EVALUATION OF THE PRINCIPLES OF TECHNOLOGY CURRICULUM MATERIALS

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FOREWORD

Rapidly accelerating technological advances in all phases of our lives, but especially in the workplace, have created an increasing need for vocational education students to understand fundamental principles about the work they may pursue. The development of curriculum materials for teachers and students is an essential step in the process of assuring that students acquire an understanding of technological principles.

The Center for Occupational Research (CORD), Waco, Texas, and the Agency for Instructional Technology (AIT), Bloomington, Indiana, have been working with a consortium of State agencies for vocational education to develop curriculum materials dealing with the principles of technology as they apply to the mechanical, fluidal, thermal, and electrical energy systems of modern equipment. CORD and AIT in conjunction with the participating States designed formative evaluation processes to be used during the 2-year effort. The National Center for Research in Vocational Education became involved with the Principles of Technology effort during the last part of the first year of implementation of the curriculum materials. Given this entry point, the role of the National Center has been one of reviewing the already operationalized formative evaluation design and making suggestions for improving the formative evaluation.

The National Center expresses its appreciation to the CORD and AIT staff members who were most cooperative in this effort. Evaluation managers at AIT, Bill Johnston and Jim Shea were especially helpful. Dr. Tim Wentling, Professor, University of Illinois, and Phillip Rollain, Project Coordinator, North Carolina Department of Public Instruction, served as panel members to review the National Center formative evaluation suggestions. The National Center is also appreciative of the reviews provided by Dr. John Washburn, Manager, Research and Development, Illinois Department of Adult Vocational-Technical Education.

The National Center is indebted to the staff who worked on this task. The study was conducted in the Evaluation and Policy Division, Dr. N.L. McCaslin, Associate Director. Dr. Floyd L. McKinney, Senior Research Specialist, served as project director, and Alan Kohan served as Graduate Research Associate.

Funding for the study was provided by the Office of Vocational and Adult Education, U.S. Department of Education.

Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

The focus of this task was to improve the formative evaluation design for the Principles of Technology (PT) curriculum materials. The Principles of Technology curriculum materials were designed to prepare secondary students for technical careers in the complex and rapidly changing technological field. The curriculum materials were developed by staff of the Center for Occupational Research and Development and the Agency for Instructional Technology working with a consortium of 35 State and Canadian vocational education agencies. The curriculum is comprised of 14 units, with each unit dealing with one principle of technology as it applies to the mechanical, fluidal, thermal, and electrical energy systems of modern equipment.

This task was a 12-month effort that began on January 16, 1985. Thus, National Center staff entered the Principles of Technology 2-year formative evaluation effort at approximately the midpoint of the PT evaluation time line. The formative evaluation design for units 1-7 was developed and implemented prior to the entry of the National Center in the formative evaluation effort. Given this set of circumstances, National Center staff reviewed the formative evaluation activities already being conducted by AIT/CORD and made suggestions for improving the evaluation effort. Minor changes were suggested in the formative evaluation instruments used by teachers and students. The major suggestion for improving the formative evaluation was the use of case studies. The case studies provided the curriculum developers with greater depth of information about the enormously complex setting in which local schools were attempting to implement PT.

The following recommendations are based on staff involvement with the design for the formative evaluation of the Principles of Technology curriculum effort, previous evaluation efforts, and reviews of relevant literature:

- The designing of a formative evaluation effort should be done concurrently with the development of the curriculum and the development of strategies for field testing the curriculum.
- The purpose and nature of formative evaluation should be thoroughly explained for all concerned parties so that expectations for results do not overburden or undercut the evaluation effort.
- Extensive use of the telephone or other means that permit two-way communication should be made by the curriculum developer/evaluator and the curriculum user (teachers, students). However, this should not be construed as an acceptable substitute for on-site, in-depth observations, interviews, and document or record reviews.

CHAPTER 1

INTRODUCTION

This report describes the involvement of the National Center for Research in Vocational Education with the Center for Occupational Research and Development (CORD), Waco, Texas, and the Agency for Instructional Technology (AIT), Bloomington, Indiana, concerning the formative evaluation of the Principles of Technology curriculum materials. In this chapter a brief overview of the Principles of Technology effort is presented so that the reader will have a better understanding of the National Center's involvement in the formative evaluation.

The Principles of Technology curriculum is designed to prepare students for technical careers in the complex and rapidly changing technological field. Based on the Unified Technical Concepts (UTC) course developed by CORD, the curriculum is comprised of 14 units, each addressing one principle of technology as it applies to the mechanical, fluidal, thermal, and electrical energy systems of modern equipment. Because the design and operation of modern equipment undergo constant change, technicians, if they are to adapt to the changing workplace, need to know the fundamental principles on which such equipment operates. Then, once technicians understand the principles on which their work is based, they can apply these principles to new work situations as the need develops.

The development of the Principles of Technology curriculum was a cooperative effort comprised of 35 State and provincial vocational education agencies in association with AIT and CORD. Inherent to the development process for the Principles of Technology curriculum was the assumption that this process is based on approximate and imperfect knowledge. Therefore, verification of the curriculum during its development process was essential to ensure that the final product was internally consistent and effective. However, internal and external constraints necessitated compromises between ideal evaluation procedures on one hand and feasibility on the other. The problem was to design a formative evaluation for the Principles of Technology Curriculum that could be accomplished with a relatively small investment of time; provided specific revision feedback about the effectiveness of the overall learning system, including the printed materials, lab activities, learning kits, displays, and audiovisual materials; did not confuse or frustrate trainees during their coursework; and provided quick results.

Objectives

The National Center had two task objectives:

- To design a formative evaluation for the Principles of Technology curriculum materials
- To assess the implementation of the evaluation design

The target audience for this task was the AIT evaluation staff. The intended use of the formative evaluation suggestions generated by the task staff was for improvement of the formative evaluation of the PT curriculum materials.

Principles of Technology

History

The content of the Principles of Technology curriculum was based on the UTC instructional model developed about 7 years ago by CORD for use at the postsecondary, associate degree level. Perhaps the most interesting aspect of the UTC curriculum was the manner in which the key elements of technology--electrical, mechanical, fluidal, and thermal principles--were presented. Rather than being presented as isolated concepts, the key elements of technology in the UTC curriculum were presented together as analogous phenomena. Moreover, the UTC curriculum was oriented toward preparing students for high-technology occupations by providing a broad-based background in applied physics. Industrial applications of the UTC principles were emphasized throughout the curriculum.

The need for a similar system of instruction at the secondary level is being acknowledged by state departments of education. The increased requirements in math and science for graduation from high school have made it more difficult for high school students to complete a traditional vocational education program. Furthermore, the increasing emphasis on technological literacy and a somewhat decreasing emphasis on specific job-skill training at the secondary level have added legitimate pressures for changing the focus of secondary vocational education programs. By April 1983, the increased interest in having the UTC curriculum adapted for implementation at the secondary level led to the formation of a consortium of about 30 States to initiate development of such a curriculum. From an economic standpoint, the consortium, in association with CORD and AIT, was a feasible strategy for the initial development of the Principles of Technology curriculum. The prospectus for the project was issued in June 1983, and the initial development work began in November 1983. Currently, the consortium membership is comprised of a total of 35 States and Canadian provinces and represents an investment of approximately $2.5 million for the development of the Principles of Technology curriculum.

Overview of Initial Formative Evaluation Process

In cooperation with CORD, AIT was responsible for the formative evaluation of the Principles of Technology curriculum. CORD was responsible for developing the unit objectives and printed materials. Video programs were developed by AIT. An outside review team, comprised of eight members (appendix A), reviewed all materials before pilot testing. Consortium agencies also received curriculum materials for review prior to the pilot tests.

An important part of the developmental process was a pilot test of each instructional unit in actual classroom settings. The primary purposes of the pilot test were to determine how well the materials were working and to identify specific problems with the materials. Each consortium agency was allotted two pilot-test sites. Test sites and teachers, however, were selected by the respective States and provinces. AIT had no control over the test site selection criteria.

Pilot-test evaluation materials were comprised of a pretest and a posttest, a student attitude questionnaire, and a detailed teacher questionnaire (appendix B). In brief, teachers administered the pretest prior to teaching the unit. While the unit was being taught, teachers recorded their reactions to the unit on the detailed teacher questionnaire. At the conclusion of the unit, teachers administered the posttest and student attitude questionnaire. The pretest, posttest, student questionnaire, and teacher questionnaire were scored and analyzed by AIT staff.

In May 1984, a 1-week tryout of the pilot-test procedures was conducted at a vocational school in Tulsa, Oklahoma. A preliminary version of the materials for the subunit "Force in Mechanical Systems" was used in the tryout. One teacher and nine students participated in the tryout. Observers were present during the 5 days of instruction. Overall, AIT staff concluded that the Oklahoma tryout was useful in identifying positive indications about the curriculum and evaluation procedures as well as in identifying some legitimate concerns.

In June 1984, a Principles of Technology teacher orientation meeting was held in Dallas, Texas. Approximately 60 teachers participated. The primary purpose of the workshop was to orient pilot-test teachers to the Principles of Technology curriculum and its instructional plan and to explain formative evaluation data collection activities and procedures for the upcoming pilot-test year.

Instructional units 1-7 were pilot-tested from September 1984 to June 1985. Of the original 60 pilot-test teachers, about 30 teachers completed all of the evaluation forms during the first pilot-test year. Although there was a variety of reasons why test site schools did not fully participate, the overall reason appeared to be a problem in obtaining the necessary instructional equipment and/or school funds to purchase program start-up equipment. Nevertheless, approximately 400-600 students participated in the first-year pilot test.

An overview of the project time line for the curriculum material production and development is presented in appendix C. Instructional units 1-7 were released in their final form during the period July-November 1985. The pilot-testing of units 8-14 began in September 1985, and they were scheduled for final release in September 1986.

CHAPTER 2

FORMATIVE EVALUATION FOR CURRICULUM DEVELOPMENT

Two essential activities in considering suggestions for improving the formative evaluation of the Principles of Technology curriculum materials were the following: (1) identifying relevant information needs and (2) reviewing alternative approaches that might have desirable features for consideration. The following sections describe task efforts for these two activities.

A Classification of Ideal Information Needs

Sanders and Cunningham (1973) categorized three major sources of information as being essential for the formative evaluation of educational materials. (See table 1.) Although the categories were not mutually exclusive or exhaustive, Sanders and Cunningham noted that the important point was not the classification scheme in and of itself, but that no source of information should be overlooked, given project resources and constraints.

Selected Alternative Approaches to Formative Evaluation

According to Dick and Carey (1978),

> formative evaluation is the process used to obtain data for instructors to use to increase the efficiency and effectiveness of their instructional materials. The emphasis in formative evaluation is on the collection of data in order to revise the individual materials, to make the materials as effective as possible. (p. 159)

Dick and Carey noted that when the instructional materials are in their final form, "other people may collect data to determine whether the materials should be used in a particular setting or whether they are effective as claimed" (p. 159).

Sarapin (1981) noted that the foundation for formative evaluation for curriculum development and improvement was based upon evaluation methodology reported by Scriven (1967), Stake (1967), Stufflebeam (1967, 1969), Stufflebeam et al. (1971), and Provus (1969). Several scholars (Abedor 1971; Sanders and Cunningham 1973; Baker and Alkin 1973; Dick and Carey 1978, 1985; and Sarapin 1981) have conceptualized formative evaluation models and procedures. From these conceptualizations, various approaches to formative evaluation have emerged. Brief descriptions of these approaches that were identified as being pertinent to the Principles of Technology project are highlighted in the following subsections.

TABLE 1

A CLASSIFICATION OF INFORMATION NEEDS IN FORMATIVE EVALUATION

I. Internal information

  A. Descriptive information

    1. Physical specification
    2. Rationale, goals, and objectives
    3. Content
    4. Other

  B. Critical appraisal

    1. Author (developer)
    2. Experts (subject matter, media, psychologists, and so forth)
    3. Students using the materials
    4. Teachers using the materials
    5. Relevant others

II. External information

  A. Assessment of the effects of the materials on student behavior

    1. Achievement
    2. Attitude
    3. Skill
    4. Interest
    5. Commitment
    6. Other

  B. Assessment of the effects of the materials on behavior

    1. Attitude
    2. Interest
    3. Commitment
    4. Competency
    5. Teaching strategy
    6. Other

TABLE 1--Continued

C. Assessment of the effects of the materials on the behavior of relevant others

    1. Parents
    2. Administrators
    3. Teachers not using the materials
    4. Students not using the materials
    5. The community
    6. Other

III. Contextual information

A. Student characteristics
B. Teacher characteristics
C. School characteristics
D. Community characteristics
E. Curricular characteristics
F. Other relevant elements in the learning environment

SOURCE: Sanders and Cunningham (1973, p. 218).

Clinical Approach (One-to-One)

Lowe, Thurston, and Brown (1983) described a one-to-one evaluation process they used in a curriculum development project for the Kingdom of Saudi Arabia. Because of their project's needs and constraints, they selected a learner verification approach as the most appropriate. They found that the clinical procedure was efficient, cost-effective, and reliable.

The clinical approach to learner verification involved working with one student at a time. Each student, as he or she worked through a complete learning sequence, was closely observed by an experienced evaluator and subject matter expert. When a student encountered difficulty, the evaluator questioned the student until the source of difficulty was identified. The subject-matter expert assisted in equipment setup and was responsible for student assessment on the learning objectives. Incorrect answers to test items were discussed with the student so that a determination could be made as to why the student chose the incorrect answer.

The authors noted that at the end of the evaluation session, the evaluator debriefed the student by asking a series of questions about the material and its effectiveness. Once the student responses and comments of the evaluator and subject-matter experts were summarized, revisions were made by the development team. A second one-to-one evaluation session was conducted. The authors noted that additional evaluation sessions were not found to be cost-effective or time-effective.

Small-Group Trial

In the formative evaluation sequence proposed by Dick and Carey (1978), small-group trials follow one-to-one evaluations. After the materials have been revised on the basis of the one-to-one evaluation, the typical procedure is to select 10-20 students to participate in a small-group evaluation of the revised materials. Usually, the materials are administered in the manner in which they are expected to be used when they are in their final form. Pretests are administered before instruction begins. After the students complete the materials, they take a posttest. According to Dick and Carey, the instructor does not intervene during the instructional process unless equipment or instructional problems prevent the student(s) from advancing through the materials. The problems encountered by the students and how the problems were solved should be noted in the evaluation data. Dick and Carey noted that student attitude questionnaires and discussions with students are appropriate during the small group trial.

Recent research found that it might be possible to eliminate either the one-to-one or small-group stage in the formative evaluation sequence proposed by Dick and Carey (1978) and still maintain effective revision of the instructional materials (Kandaswamy et al. 1976; Carey 1978; Wager 1983). Although these studies had limitations, their results indicated that formative evaluators might save time and financial resources by eliminating either the small-group step or the one-to-one step from their evaluation plan without sacrificing effectiveness.

Local Trial and Field Test

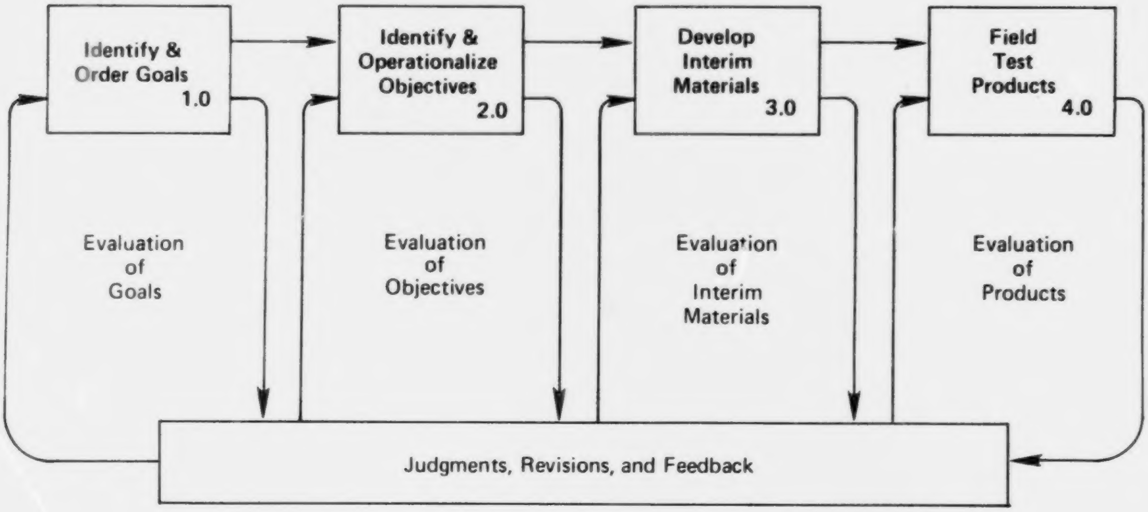
Bastion et al. (1983) described a formative evaluation approach that combined the features of the one-to-one and small-group trials into one evaluation stage that they referred to as local trial. The second stage of their evaluation approach reflected those procedures of a field test described by Dick and Carey (1978).

During the local trial, a draft of the curriculum materials is submitted to a subject-matter expert who is not a member of the curriculum development team. The subject-matter expert reviews the materials for content and recommends revisions. In addition, a small-group trial is conducted with typical learners. Students are pretested, posttested, given an attitude questionnaire, and encouraged to write comments directly on the materials.

During the field-test stage, the curriculum materials are tested in a variety of settings under conditions similar to regular course instruction. School-site staff and teachers administer the curriculum materials, pretests and posttests, and curriculum evaluation questionnaires. The curriculum development team conducts interviews with school-site administrators, teachers, and students to obtain additional formative evaluation information.

Four-Stage Formative Evaluation

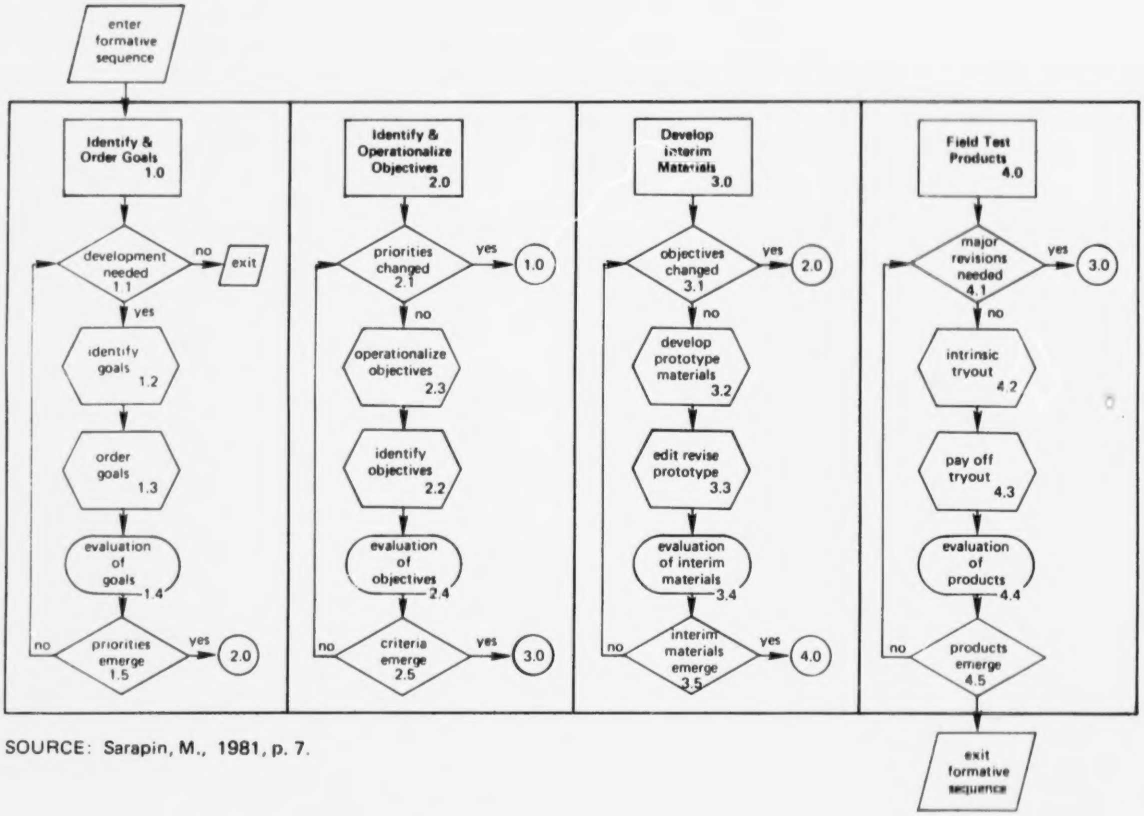
Perhaps the most ideal formative evaluation approach for facilitating instructional material development, assessment, and revision is the approach described by Sanders and Cunningham (1973) and Sarapin (1981). Sarapin developed a symbolic analogue of the framework proposed by Sanders and Cunningham to simplify the essential elements of a comprehensive formative evaluation effort. This symbolic analogue, or conceptual model, is presented in figure 1.


Identify & Order Goals 1.0
Identify & Operationalize Objectives 2.0
Develop Interim Materials 3.0
Field Test Products 4.0
Evaluation of Goals
Evaluation of Objectives
Evaluation of Interim Materials
Evaluation of Products
Judgments, Revisions, and Feedback

SOURCE: Sarapin, M., 1981, p. 6.

Figure 1. Conceptual model of four-stage formative evaluation framework

At the procedural level, Sarapin developed a formative evaluation flowchart, shown in figure 2, that made the conceptual model operational. The flowchart, according to Sarapin, is a heuristic device that should be adopted as needed for each curriculum formative evaluation effort. A detailed description of each of the four stages of this model was provided by Sarapin (1981).



enter formative sequence
Identify & Order Goals 1.0
development needed 1.1
no
exit
yes
identify goals 1.2
order goals 1.3
evaluation of goals 1.4
no
priorities emerge 1.5
yes
2.0
Identify & Operationalize Objectives 2.0
priorities changed 2.1
yes
1.0
no
operationalize objectives 2.3
identify objectives 2.2
evaluation of objectives 2.4
no
criteria emerge 2.5
yes
3.0
Develop interim Materials 3.0
objectives changed 3.1
yes
2.0
no
develop prototype materials 3.2
edit revise prototype 3.3
evaluation of interim materials 3.4
no
interim materials emerge 3.5
yes
4.0
Field Test Products 4.0
major revisions needed 4.1
yes
3.0
no
intrinsic tryout 4.2
pay off tryout 4.3
evaluation of products 4.4
no
products emerge 4.5
exit formative sequence

SOURCE: Sarapin, M., 1981, p. 7.

Figure 2. Flowchart of four-stage formative evaluation

Instructional Quality Inventory

Montague et al. (1983) noted that the Instructional Quality Inventory (IQI) is a formative evaluation process that was designed initially for military instructional development. The IQI is an internal review process that "can be applied to any systematically developed program of instruction that has goals and test items and instruction tied to the goals" (Montague et al.

1983, p. 11). The IQI process, in essence, checks to see if test items are consistent with the instructional objectives. Once the objectives and test items are consistent with each other, the next step is to ensure that the instructional materials are consistent with the objectives and test items.

Montague et al. (1983) presented an overview of the IQI procedures. Objectives and test items were classified by a task-content matrix. The IQI consisted of five procedures that judged the adequacy of objectives, test items, and instructional materials. The IQI has been found to be a cost-effective process compared with other formative evaluation methods. The authors noted, however, "that the IQI does not address either adapting instruction to students or the sequencing or structuring of content" (p. 13).

Responsive Evaluation

Stake (1975) has described the process of conducting a responsive evaluation.

> To do a responsive evaluation, the evaluator conceives of a plan of observations and negotiations. He arranges for various persons to observe the program, and with their help prepares brief narratives, portrayals, product displays, graphs, etc. He finds out what is of value to his audiences, and gathers expressions of worth from various individuals whose points of view differ. Of course, he checks the quality of his records: he gets program personnel to react to the accuracy of his portrayals; and audience members to react to the relevance of his findings. He does most of this informally--iterating and keeping a record of action and reaction. He chooses media accessible to his audiences to increase the likelihood and fidelity of communication. He might prepare a final written report, he might not--depending on what he and his clients have agreed on. (p. 14)

Responsive evaluation makes extensive use of interviews (sometimes called conversations), observations, document reviews, and record reviews in and around a given program. The concerns and issues are gathered from the persons, records, and documents involved. In responsive evaluation, the evaluator determines how best to collect data. The human instrument is most frequently used, but other means are also employed to collect needed data. Case studies are frequently used in responsive evaluation situations because of the concern for a specific "case" and because they readily lend themselves to data collection via interviews, observations, document review, and record review.

Summary

A classification of ideal information needs for formative evaluation would show that no information should be overlooked, given consideration of project resources and constraints. The emphasis of formative evaluation was described as the process of collecting data on instructional materials for the purpose of revising the materials to make them as effective as possible. The foundation for formative evaluation for curriculum development and improvement was the evaluation methodology reported by numerous scholars. Although numerous formative evaluation approaches have been developed, the following six approaches were identified as being pertinent to the Principles of Technology formative evaluation effort: (1) clinical approach, (2) small-group trial, (3) local trial and field test, (4) four-stage formative, (5) instructional quality inventory, and (6) responsive evaluation. A brief description of each approach was provided. An assessment of these six approaches, project constraints, essential features of the curriculum, and evaluation standards is included in the following chapter.

CHAPTER 3

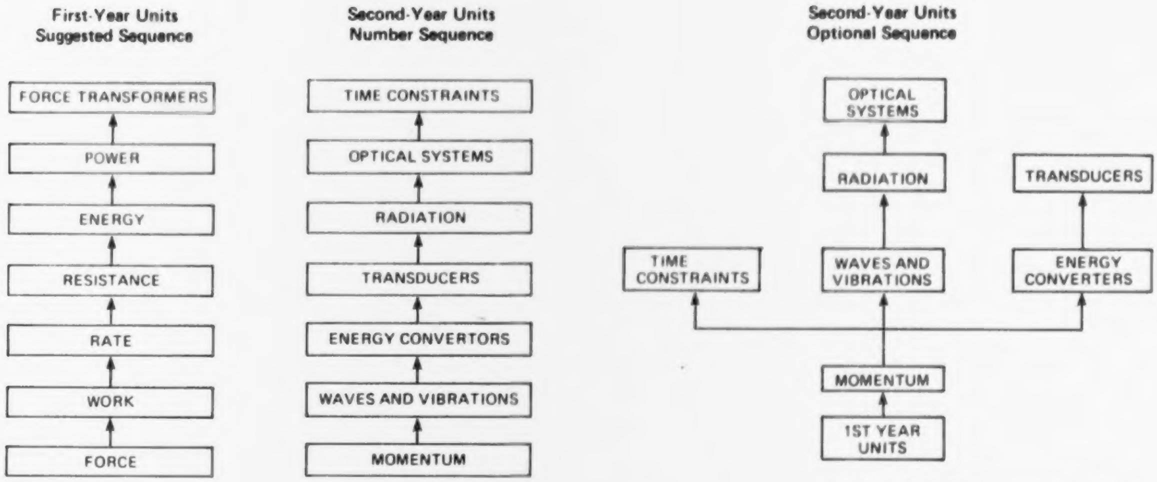
FORMATIVE EVALUATION FOR PRINCIPLES OF TECHNOLOGY CURRICULUM DEVELOPMENT EFFORT

Principles of Technology Curriculum Overview

Printed Teaching Materials

The Principles of Technology student text is systematically divided into 14 units. Each unit covers one technical concept and contains an overview of the unit, subunits, and a summary. Each subunit deals with the unit's major technical concept as it applies in one of the four energy systems, and each subunit has lecture materials, a suggested demonstration to use with the lecture portion, a math skills lab, and two hands-on physics application labs. A summary of the important concepts concludes the unit. A glossary of key words and activities for improving math skills are included in the unit's appendix. Finally, an end-of-unit exercise is provided to review the main ideas and definitions presented in the units.

The target audience for units 1-7 and units 8-14 are 11th and 12th graders, respectively. Typically, the 14 units are presented over 2 years and in the sequence delineated in figure 3. Furthermore, 10th graders and students who are in the academic tracks may


First-Year Units
Suggested Sequence
FORCE TRANSFORMERS
POWER
ENERGY
RESISTANCE
RATE
WORK
FORCE
Second-Year Units
Number Sequence
TIME CONSTRAINTS
OPTICAL SYSTEMS
RADIATION
TRANSDUCERS
ENERGY CONVERTORS
WAVES AND VIBRATIONS
MOMENTUM
Second-Year Units
Optional Sequence
OPTICAL SYSTEMS
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ENERGY CONVERTERS
MOMENTUM
1ST YEAR UNITS

*In the second year, Momentum must be taught first The order of instruction is then flexibible, with some exceptions. Radiation must precede Optical Systems Waves and Vibrations must precede Radiation Energy Convertors must precede Transducers

SOURCE: Center for Occupational Research and Development, 1985, p. A-3.

Figure 3. Principles of technology instructional unit sequence

find the curriculum useful and beneficial. However, students enrolled in Principles of Technology should be able to read at least at the 8th-grade level and have satisfactorily completed 1 year of high school general mathematics. Previous or concurrent enrollment in algebra is desirable.

The teaching plan for a typical unit is depicted in figure 4. Each rectangle represents 50 minutes of instruction. Most units require 26 class sessions. The first class for each unit is an introduction and overview of the unit's content. The first two sessions of the subunit include the video presentation and lecture and discussions. The third session is a math skills lab. The next two sessions are hands-on physics application labs. The last class session of the subunit is a review of the material. The last class of the unit is a unit summary and test.

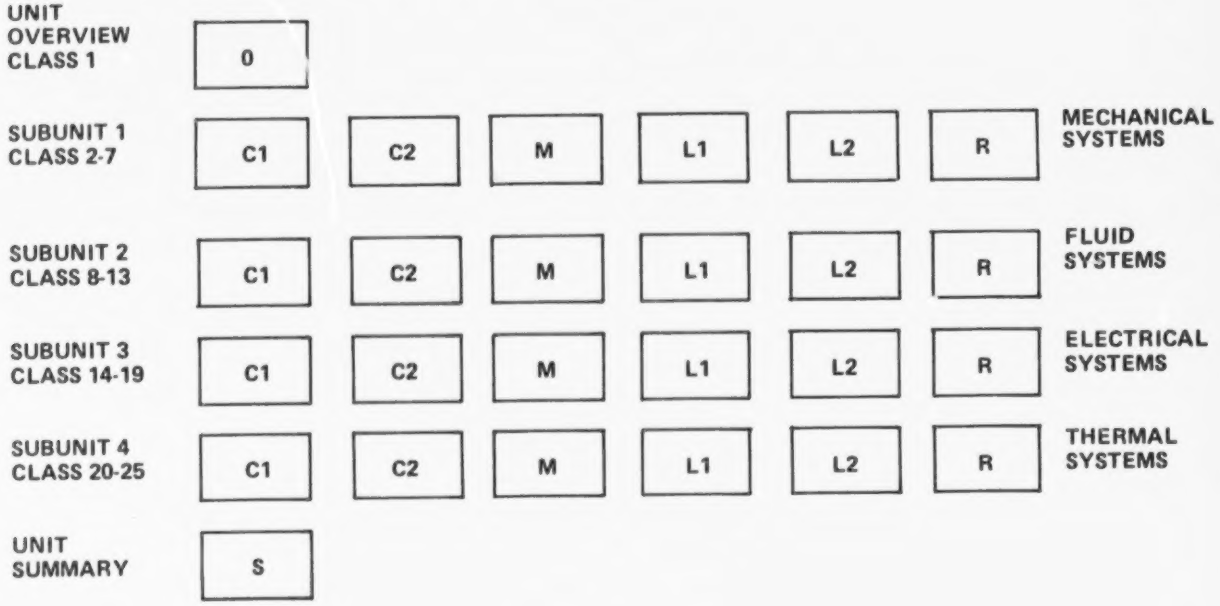

UNIT OVERVIEW CLASS 1
0
SUBUNIT 1 CLASS 2-7
C1
C2
M
L1
L2
R
MECHANICAL SYSTEMS
SUBUNIT 2 CLASS 8-13
C1
C2
M
L1
L2
R
FLUID SYSTEMS
SUBUNIT 3 CLASS 14-19
C1
C2
M
L1
L2
R
ELECTRICAL SYSTEMS
SUBUNIT 4 CLASS 20-25
C1
C2
M
L1
L2
R
THERMAL SYSTEMS
UNIT SUMMARY
S

Figure 4. Schematic of a typical instructional unit teaching plan

For each instructional unit there is a teacher's guide, which provides suggestions for teaching each class session. The guide is not a set of rigid rules or a substitute for teacher ingenuity, but it is a useful tool for implementing the Principles of Technology course.

Video

There are about 78 video programs that total approximately 500 minutes infused throughout units 1-14. The video segments introduce ideas presented in the text. Through the video program students are taken to the workplace settings where technicians are employed. The video segments were designed as a tool for putting variety into the classroom teaching pattern.

Equipment and Facilities

A standard-size classroom or laboratory space sufficient to accommodate one to five laboratory stations per class is needed to implement the Principles of Technology units. Depending upon class size and availability of equipment, lab space must be flexible to accommodate a variety of lab station activities. A videocassette player (1/2" Beta, 1" VHS, or 3/4" U-matic) and a color monitor are needed for the video segments. The cost of equipping each lab station for the first year is approximately $4,000-$6,000. Demonstration and laboratory equipment may be locally available, may need to be fabricated, or may need to be ordered from commercial vendors. Laboratory and equipment specifications are delineated in the teacher's guide.

First-Year Formative Evaluation Effort

The National Center designated study Design and Assessment of the Formative Evaluation of Principles of Technology Curriculum Materials had a 12-month contract that commenced on January 16, 1985. Thus, National Center project staff entered the Principles of Technology 2-year formative evaluation effort at approximately the midpoint of the AIT evaluation time line. In fact, the evaluation design for units 1-7 was developed and implemented prior to the entry of the National Center into the formative evaluation effort.

The first-year evaluation plan, as developed by AIT, is depicted in table 2. The entire data collection instrument package used by AIT is presented in appendix B.

Descriptive statistics were used to analyze the data from the student and teacher questionnaires. Responses from open-ended questions were summarized and evaluated by AIT project staff as to their merit for improving the curriculum materials. Student pretest and posttest scores were subjected to analysis of covariance that controlled the effects of student sex and grade level, teacher background, and teaching pattern.

Essential Features of Principles of Technology Curriculum Effort

One of the initial steps in the design of the formative evaluation by National Center staff was the identification of those features considered essential and unique to the Principles of Technology curriculum. The essential features, together with the likely constraints and the evaluation standards established by the Joint Committee on Standards for Education Evaluation (utility, feasibility, propriety, and accuracy), served to guide the task staff in analyzing alternative formative evaluation designs. Selecting suggestions for strengthening the formative evaluation by National Center staff was essentially a critical judgmental process involving trade-offs among the essential features and evaluation standards. The essential features of the Principles of Technology curriculum effort, identified by National Center staff, are discussed in the following sections.

TABLE 2

PRINCIPLES OF TECHNOLOGY EVALUATION PLAN

Project Materials	Data Source	Assessment Focus	Instrument	When
Video/Student Handbook/Labs	Students	Overall Instructional Impact	Pre/posttest Questionnaire	1 subunit for each unit and 1 unit
All	Teachers	Manageability of components, clarity of materials, appropriateness for target audience, perceived educational worth	Questionnaire and structured log	At conclusion of each unit
All	Consortium/Consortium Review Team	Clarity, appropriateness, materials link	None for review team/ Questionnaires for full consortium	As each unit is developed

Instructional Materials

The comprehensive student text, video, and teacher's guide are essential for the successful implementation of the Principles of Technology curriculum. Therefore, these materials form a total instructional package that needs to be included in the formative evaluation. For example, do the video and printed materials correlate in terms of textual and graphic illustration? Is the terminology consistent throughout the instructional materials?

Equipment and Facilities

The application laboratories are essential for successful implementation of the curriculum. Lab space must be flexible to accommodate a variety of lab station activities. A videocassette player and a color monitor are required. Specifically, was consideration given to equipment cost, utility, adaptability, and availability? Are laboratory and equipment setup specifications provided? If special equipment needs to be fabricated, are design specifications adequately described?

Teacher Background

Teachers from the existing faculty who have an interest in vocational students should teach Principles of Technology. These teachers should be familiar with or willing and able to become familiar with the physics and mathematics in the course. Team teaching may be required if qualified teachers are not available.

Student Background

The Principles of Technology curriculum is designed for 11th- and 12th-grade students who are interested in technical careers. Tenth-grade and nonvocational students also may want to enroll, and they should be accommodated. Students should have at least an eighth-grade reading level and should have had at least 1 year of general mathematics. Previous or concurrent enrollment in algebra would be helpful.

Although the following features are not unique to the curriculum, they are essential for successful implementation.

School Counselor Cooperation

School counselors should be knowledgeable of the purpose, content, and prerequisites of the Principles of Technology curriculum so that proper counseling can be given to potential students and to currently enrolled students.

School Administrator Support

School-site administrative support and leadership are essential to the successful implementation of Principles of Technology. School-site administrators play a pivotal role in eliciting the support of the school board, the community, and the school's faculty and staff.

Community Support

Parents, business and industry, and concerned citizens should be knowledgeable of the purpose and general content of the Principles of Technology curriculum so that meaningful community cooperation can be elicited in the implementation effort.

School Characteristics

Individual school culture and climate would affect implementation of the Principles of Technology curriculum, as would the size of the school, students' and teachers' backgrounds and their relationships with each other, their attitudes toward new curriculum and toward schooling in general, school-site leadership, and the socioeconomic status of the student population.

Information Activities

A well-planned public relations effort is essential for eliciting school and community support for the Principles of Technology curriculum. Information activities are needed at the National, State, and local levels to inform potential students, counselors, teachers, school administrators, and community and business leaders about the new curriculum.

Constraints on Formative Evaluation Design Potential

Numerous constraints on the Principles of Technology formative evaluation effort were identified by National Center and AIT staff. Although these constraints did not make the evaluation impossible, they did alert the evaluators to potential problems and limitations that needed to be addressed in the formative evaluation design. The following sections highlight the more serious constraints on the Principles of Technology formative evaluation.

Insufficient Resources

Two obvious and uncontrollable factors that limit the Principles of Technology formative evaluation effort are time and financial resource constraints. Given pilot-test time lines of September 1984 through June 1986 for units 1-7 and September 1985 through June 1986 for units 8-14, time became a severe restriction on the formative evaluation effort. Moreover, National Center staff were limited by time in what they could propose as a useful and feasible formative evaluation supplemental design, and their project budget constraints precluded them from conducting evaluation activities that they proposed. Likewise, the AIT project staff members were limited by their budget on the number and type of additional evaluation activities they could undertake. In summation, given time and budget constraints, the development of an effective, efficient, and feasible formative evaluation design that would enhance current Principles of Technology evaluation activities presented a challenge to all involved.

Data Collection Limitations

The rights and welfare of human subjects participating in the formative evaluation needed to be respected and protected. Moral, ethical, and legal codes needed to be followed. To ensure that information was not obtained illegally or unethically, data collection efforts had to conform to the rights of human subjects. This reality imposed limitations on "what" and "how" information was collected.

External Constraints

A number of persistent external constraints affected the project.

Equipment problems. Test site variability in the success of obtaining correct laboratory equipment and proper equipment setup was an uncontrollable factor that affected test site evaluation results.

Lack of demographic contextual data. Student and teacher background data may not be representative of the target population. Information about school climate and culture and about students' and teachers' perceptions of the curriculum and classroom climate was lacking. The lack of demographic/contextual data imposed restrictions on interpretation of evaluation results.

Variability in teaching pattern. Variability in length of classroom instruction, number of classes per unit, number and type of homework assignments, teacher enthusiasm, and out of class assistance constituted uncontrollable factors that affected evaluation results.

First-Year Evaluation Design

In essence, the first-year evaluation design was a field test that utilized a one-group pretest-posttest design as a means of measuring criteria performance. Threats to the internal validity of this design were numerous. No control groups were utilized; therefore, the following threats to validity imposed serious constraints on the interpretation of posttest results.

History. For example, during the time of a particular unit of instruction, did students receive any outside learning assistance from relatives, tutors, TV, friends, and so forth? If so, it would be difficult to interpret posttest scores accurately. Did the instructional unit account for the difference between pre- and posttest scores, or did the outside help account for the difference?

Testing. Since the pre- and posttest instruments were identical, there may be a practice effect or pretest sensitization. However, this threat was addressed by minimizing memory effects.

Instrumentation. Perhaps the most serious threat to the validity of the results pertained to the validity and reliability of the pre- and posttests. Interpretation of the posttest results must consider the lack of validity and reliability information for the measurement instruments.

Regression. This is a subtle phenomenon that needs to be considered when interpreting posttest results. Regression suggests that students who scored low on the pretest will tend to regress toward the mean on the posttest. Conversely, students who scored high on the pretest will tend to regress toward the mean on the posttest.

Selection. Neither students nor classrooms were randomly selected. Test site selections appeared to have been volunteered by respective State staff members. In addition to threats to internal validity, there were external validity threats to the one-group pretest-posttest design.

Hawthorne effect. Since the students knew that they were participants in an evaluation, they may have tried harder than they normally would have to learn the material. Thus, their posttest scores may have increased as a result of this special attention.

Novelty effect. The newness of the curricula may excite student interest. This effect is similar to the Hawthorne effect.

No control group. A lack of a usable comparison group restricted interpretation of posttest results. Perhaps the same students in a technical physics class taught by a physics teacher would obtain the same or better results on the posttest.

Lack of random assignment. Students or teachers were not randomly assigned to treatments. The generalization of results to students and teachers who did not participate in the evaluation is not valid.

Although the aforementioned threats to internal and external validity pertain to behavioral research in general and not to formative evaluation pilot testing per se, these threats should be considered when interpreting unit posttest scores. In addition, it is impossible or impractical to deal with many of these problems in the educational setting.

Evaluation Standards

The evaluation standards established by the Joint Committee on Standards for Educational Evaluation (1981) served to guide National Center task staff in analyzing alternative formative evaluation designs. The Joint Committee identified four important attributes of an evaluation: utility, feasibility, propriety, and accuracy, and stated, "The Committee is satisfied that standards which shape an evaluation so that it has these four characteristics are necessary and sufficient for sound evaluation in education" (p. 13). The four standards, as they applied to formative evaluation, are described in the following subsections.

Utility

Information scope and selection. The information collected by the formative evaluation should be sufficient to support a judgment of worth and merit and should answer all relevant formative evaluation questions.

Clarity of information. The information collected should respond clearly and without generalities to the formative evaluation objectives, provide a firm foundation for formative evaluation conclusions and recommendations, and be characterized by conciseness and logical development so that it communicated to the formative evaluation audiences.

Timeliness. The formative evaluation should provide information to the curriculum developers at the time when the information can best be used. The most critical information needs of the curriculum developer must be met on time to avoid delays in curriculum revision decisions.

Feasibility

Practical procedures. The formative evaluation procedures suggested by National Center staff should be realistic and practical, given the time and financial constraints inherent in the formative evaluation project. School and classroom disruptions should be kept to a minimum.

Political viability. The formative evaluation procedures should be politically viable given the various interest groups and stakeholders in the Principles of Technology curriculum project. In essence, the formative evaluation procedures are politically viable if their purpose is achieved despite pressures created by the formal and informal organizational power structures of the State and local levels.

Cost-effectiveness. The evaluation has to produce information of sufficient value to justify its expense. The question of whether there are alternative evaluation approaches that would produce more useful information at the same or less cost needs to be addressed. The information needed should be obtained as economically as possible.

Propriety

Rights of human subjects. The formative evaluation should protect the rights and welfare of human subjects. Legal, ethical, and common sense considerations should be followed.

Conflicts of interest. The formative evaluation should take into consideration the fact that conflicts of interest may arise during the formative evaluation effort. Strategies should be developed for dealing with conflicts so that the evaluation process and results will not be compromised.

Balanced reporting. The formative evaluation should be complete and fair in its presentation of strengths and weaknesses, and both negative and positive aspects of the curriculum evaluation should be reported. Strengths and weaknesses should not be manipulated to please partisan interest groups. All evaluation findings, even those that might prove embarrassing to partisan interest groups, should be included in pilot-test findings.

Accuracy

Clearly identified object. The object of the formative evaluation should be clearly identified and described realistically. Unique features of the object should be identified. In summation, the descriptions and unique features of the object should be a valid characterization of the object.

Appropriate information sources. The formative evaluation must provide adequate information to the curriculum developers. Multiple information sources should be utilized. Information sources should be tapped using a variety of methods, such as interviews, surveys, observations, and document reviews. In essence, the information sources should answer the evaluative questions.

Adequacy of contextual information. Contextual information should be used in the interpretation of formative evaluation results. For example, the curriculum developers should know whether a particular unit's success or failure was influenced by student socioeconomic status, teacher background, student academic background, school climate, teacher and administrator support or resistance toward the curriculum, and/or community support or apathy toward the curriculum.

Purposes and procedures explicated. Purposes and procedures of the formative evaluation must be understood by those involved in the formative evaluation effort. Specifically, the objectives of the evaluation need to be clear. Procedures on how information was collected, organized, analyzed, and reported should be described in sufficient detail so that other evaluators could conduct a similar evaluation in other settings.

Propriety rights of human subjects. The rights and welfare of human subjects need to be respected and protected. Legal, ethical, and common sense considerations need to be followed.

Conflicts of interest. Conflicts of interest should be avoided. If conflicts of interest arise, they should be dealt with so that the evaluation process and results are not compromised.

Balanced reporting. The formative evaluation should be complete and fair in its presentation of strengths and weaknesses. Both negative and positive aspects of the curriculum evaluation should be reported. Strengths and weaknesses should not be manipulated to please partisan interest groups. In fact, evaluation findings that might prove embarrassing to partisan interest groups should not be omitted from evaluation findings.

Assessment of Alternative Formative Evaluation Approaches

The essential features of the Principles of Technology curriculum, together with the constraints and the evaluation standards established by the Joint Commission, served as a guide for assessing the formative evaluation approaches identified by National Center staff. In essence, the assessment was a critical judgment process that involved trade-offs among the essential features, information needs, constraints, and evaluation standards. Suggestions for strengthening the first-year Principles of Technology formative evaluation effort emerged from this process.

The results of the assessment of information needs in relation to evaluation standards are delineated in table 3. The information needs specified in table 3 are identical to those listed in table 1. Ideally, the Principles of Technology formative evaluation design should satisfy the information needs listed. However, project constraints limited the number and type of data collection activities that could be conducted.

TABLE 3

ASSESSMENT OF INFORMATION NEEDS IN RELATION TO EVALUATION STANDARDS

Evaluation Design Information Needs	Evaluation Standards			
	Utility	Feasibility	Propriety	Accuracy
I. Internal information A. Descriptive 1. Physical specifications 2. Rationale, goals, objectives 3. Content	Y	Y	Y	Y
B. Critical Appraisal 1. Developer 2. Subject matter experts 3. Students using the material 4. Teachers using the materials	Y	Y	Y	Y

TABLE 3--Continued

Evaluation Design Information Needs	Evaluation Standards			
	Utility	Feasibility	Propriety	Accuracy
II. External Information A. Interim Effects of the Materials on Student Behavior 1. Achievement 2. Attitude 3. Skill 4. Interest 5. Commitment	Y	P	Y	Y
B. Interim Effects of the Materials on Teacher Behavior 1. Attitude 2. Interest 3. Commitment 4. Competency 5. The community	Y	P	Y	Y
III. Contextual Information A. Student Characteristics B. Teacher Characteristics C. School Characteristics D. Community Characteristics E. Curricular Characteristics	Y	P	Y	Y

KEY: Y= Yes, satisfactorily meets the criteria
P= Partially meets the criteria
N= No, does not meet the criteria

Specifically, it was judged feasible to investigate the interim effects of the curriculum materials on students and teachers not using the curriculum. Project constraints also prevented an in-depth collection of contextual information about student, teacher, school, and community characteristics. Project staff judged information collection activities concerning the interim effects of the curriculum materials on student and teacher behavior to be feasible. Specifically, the measurement of student and teacher attitudes toward the curriculum as well as the measurement of student achievement appeared to be the most feasible data collection activities on interim effects. Internal information needs were, for the most part, being met by existing Principles of Technology formative evaluation activities.

The second step in the critical judgment process was to assess the alternative formative evaluation approaches against the evaluation standards criteria. The information needs that were judged as meeting the evaluation standards in the first assessment were included under the utility standards of the second assessment. The four standards were then crossed with the alternative evaluation approaches. National Center staff assessed these alternative approaches by assigning a numerical value to each criterion. The results of this assessment are presented in table 4.

The results of the alternative evaluation approach assessment revealed that no single approach emerged as the optimal method for the formative evaluation of the Principles of Technology curriculum. It was decided that an eclectic approach would most likely incorporate appropriate features of the approaches that best met the evaluation criteria.

As shown in table 4, two approaches were judged to meet the evaluation criteria best: (1) local trial and field test and (2) responsive evaluation. The local trial and field test approach was judged more feasible than responsive evaluation. Conversely, responsive evaluation was judged more useful than the local trial and field test approach. The logical conclusion was to combine those features of both approaches that best fit the needs of the Principles of Technology formative evaluation effort. Consequently, the last step in the critical judgment process was to compare the first-year evaluation effort approach with features of the local trial and field test and responsive evaluation approaches so that elements of the eclectic approach could be identified that would strengthen current evaluation efforts.

Selected Design Elements to Strengthen Current Evaluation Efforts

When the first-year evaluation approach was compared with the local trial and field test and responsive evaluation approaches, information voids were identified that could be filled in the second-year evaluation effort. Specifically, responsive evaluation could collect, through the case-study method, qualitative

TABLE 4

ASSESSMENT OF ALTERNATIVE FORMATIVE EVALUATION
APPROACHES AGAINST EVALUATION STANDARDS

Alternative Formative Evaluation Approaches	Evaluation Standards				
	Utility	Feasibility	Propriety	Accuracy	
	Information Needs	Practical Procedures Given Constraints and Essential Features	Rights of Human Subjects	Defensible Information Sources	Total Points
Clinical Approach (One-to-One)	1	1	5	3	10
Small-Group Trial	3	3	5	3	14
Local Trial and Field Test	3	5	5	5	18
Four-Stage Formative	5	1	5	5	16
Instructional Quality Inventory	1	1	5	5	12
Responsive Evaluation	5	3	5	5	18

KEY: 5= Satisfactorily met the criteria
3= Partially met the criteria
1= Minimally met the criteria

contextual information that would be useful in helping to interpret the interim effects of the curriculum on students, teachers, and school-site staff. Interviews with teachers, students, and school administrators, in particular, would enhance the second-year evaluation effort. Moreover, classroom observations and document reviews would provide additional insights to the interim effects of the curriculum.

In essence, the first-year evaluation was similar to a local trial and field test approach. Instructional units were submitted to subject-matter experts for content review. Although small-group trials were not conducted, the instructional units were field tested in a variety of settings (comprehensive high schools, vocational schools, teachers with varying academic and work experiences, students with varying academic and work backgrounds, and so forth). Students were pretested before each unit and were administered a posttest and attitude questionnaire at the completion of each unit. For each unit, teachers completed a detailed forced choice and open-ended questionnaire that allowed them to record their daily reactions and suggestions for improving the unit.

National Center staff believed that the student and teacher questionnaires could be strengthened by focusing their data collection activities on the essential features of the curriculum. A Likert-type format was proposed. The data collection approach proposed by National Center staff for strengthening the Principles of Technology formative evaluation is presented in appendix D. The data collection package was comprised of four major components: (1) a student reactionnaire; (2) a teacher reactionnaire; (3) a teacher unit daily log; and (4) case study guidelines for student, teacher, and administrator interviews, classroom observations, and document and record reviews. The total package was designed to fill the information voids of the first-year evaluation effort, given the project constraints and evaluation criteria.

CHAPTER 4

ASSESSMENT OF IMPLEMENTATION OF ESSENTIAL EVALUATION DESIGN FEATURES

Assessment Design

National Center staff assessed the extent to which the curriculum evaluators adhered to the National Center staff's evaluation suggestions that were to be implemented in the second-year field-test of the Principles of Technology curriculum. The assessment was guided by the four evaluation standards described by the Joint Committee on Standards for Educational Evaluation (1981). In essence, the assessment framework formed a matrix with the evaluation standards on one axis and the essential evaluation design features on the other axis. The assessment framework is depicted in figure 5. A description of each assessment topic area is presented in the following sections.

Utility

Information scope and selection. The audit should assess the extent to which the formative evaluation addressed the information needs of the curriculum developers. Was the information collected sufficient to support a judgment of worth and merit? Was the information useful? Were all relevant formative evaluation questions answered by the information collected from the data collection activities?

Clarity of information. The audit should assess the extent to which the formative evaluation information collected was understandable to the curriculum developers. Did the information respond clearly and without generalities to the formative evaluation objectives? Did the information provide a firm foundation for formative evaluation conclusions and recommendations? Was the information characterized by conciseness and logical development? In sum, did the information communicate to the formative evaluation audiences?

Timeliness. The audit should assess the extent to which the formative evaluation information was provided to the curriculum developers at the time when the information could best be used. Was the formative evaluation information received by the curriculum developers on scheduled time line dates? Were any curriculum revision decisions delayed as a result of late formative evaluation information? In sum, were the curriculum developers' most critical information needs met on time?

Evaluation Standards	Formative Evaluation Processes					
	Student Questionnaire	Teacher Questionnaire	Unit Daily Log	Interviews	Classroom Observations	Document and Record Reviews
Utility - Information scope and selection - Timeliness						
Feasibility - Practical procedures - Political - Viability - Cost-effectiveness						
Propriety - Right human subjects - Conflicts of interest - Balanced reporting						
Accuracy - Clearly defined object - Appropriate information sources - Adequacy of contextual information - Purposes and procedures explicated						

Figure 5. Sources of information about the feasibility, utility, accuracy, and proprietary characteristics of the formative evaluation processes

Feasibility

Practical procedures. Audit interviews and classroom observations should assess the extent to which formative evaluation procedures suggested by National Center staff were realistic given the time and financial constraints inherent in the formative evaluation project. Specifically, were the National Center evaluation procedures a practical approach to the formative evaluation of the Principles of Technology curriculum? Did these procedures minimize school and classroom disruptions? Moreover, was the evaluation conducted on a daily basis without the presence of curriculum evaluators? Were teachers informed of the purpose and procedure of the evaluation effort? Were teachers instructed on how to implement the instructional units? Did the teachers feel that they were well-prepared to teach the instructional units? Were the students informed of the evaluation purpose and procedures? Did the students feel that they were adequately prepared for participating in the formative evaluation?

Political viability. Audit interviews and classroom observations should assess the extent to which the formative evaluation procedures were politically viable given the various interest groups and stakeholders in the Principles of Technology curriculum project. In essence, the formative evaluation procedures were politically viable if the purpose of the evaluation was achieved despite pressures created by the formal and informal organizational power structures of the State and local levels. Specifically, did any political conflicts erupt over the evaluation effort? If so, what impact did these conflicts have on achieving the purpose of the evaluation?

Cost-effectiveness. The audit should assess the extent to which the evaluation was cost-effective. The evaluation should produce information of sufficient value to justify the expense of the evaluation. Were there alternative evaluation approaches that would produce more useful information at the same or less cost? Was the evaluation begun without a commitment of sufficient resources to ensure completion? For the information needed, was the evaluation conducted as economically as possible?

Propriety

Rights of human subjects. The audit should assess the extent to which the rights and welfare of human subjects were respected and protected. Were legal, ethical, and common sense considerations followed?

Conflicts of interest. The audit should assess the extent to which conflicts of interest in the formative evaluation effort were avoided. If conflicts of interest arose, how were they dealt with so that the evaluation process and results were not compromised?

Balanced reporting. The audit should assess the extent to which the formative evaluation was complete and fair in its presentation of strengths and weaknesses. Were both negative and positive aspects of the curriculum evaluation reported? Were any strengths and weaknesses manipulated to please partisan interest groups? Were any evaluation findings that might prove embarrassing to partisan interest groups omitted from pilot test findings?

Accuracy

Clearly identified object. The audit should assess the extent to which the object of the formative evaluation was clearly identified. Given project constraints, was the object of the evaluation described realistically? Were unique features of the object identified? Were the descriptions and unique features of the object valid characterizations of the object?

Appropriate information sources. The audit should assess the extent to which the formative evaluation provided adequate information to the curriculum developers. Were multiple information sources utilized? Were information sources tapped with a variety of methods, such as interviews, surveys, observations, and document reviews? In essence, to what extent did the information sources answer the evaluative questions?

Adequacy of contextual information. The audit should assess the extent to which contextual information was used in the interpretation of formative evaluation results. For example, the Principles of Technology curriculum developers should know whether a particular unit's success or failure was influenced by the students' socioeconomic status, teachers' background, students' academic background, school climate, teacher and administrator support or resistance toward the curriculum, and/or community support or apathy toward the curriculum. In sum, what contextual factors were examined, to what extent were these factors used in describing the contextual conditions of the formative evaluation effort, and how adequate was the information in helping to interpret the outcomes of the formative evaluation?

Purposes and procedures explicated. The audit should assess the extent to which the purposes and procedures of the formative evaluation were understood by those involved in the formative evaluation effort. Were the objectives of the evaluation clear? Were procedures on how information was collected, organized, analyzed, and reported clearly delineated? If the evaluation were to be replicated, are the purposes and procedures described in sufficient detail so that other evaluators could conduct a similar evaluation in other settings?

Furthermore, an overall assessment of the extent to which the essential features of the evaluation design were adhered to needed to be addressed. In essence, the overall assessment served as a summative evaluation of the information obtained from the discrete components of the design depicted in figure 4. Specifically, were the multiple data sources and data collection activities utilized? To what extent were the data collection procedures followed? Did all the field-test sites participate in the data collection activities? In sum, to what extent did the curriculum evaluators adhere to the essential evaluation features?

Data Collection

The data collection for the assessment of the evaluation suggestions proposed by the National Center was done through the review of appropriate information available at AIT headquarters, interviewing AIT evaluation staff members, observing Principles of Technology classes at two local PT pilot sites, interviewing a state-level liaison person, and interviewing students, administrators, and teachers in two local PT pilot sites. A copy of the topics/questions used to guide the interviews is provided in appendix F. In general, the interviews were unstructured, with the topical areas and questions serving as a guide to ensure that certain topics were covered in the interviews, observations, and document or record reviews.

The timing of this task (initiated after AIT/CORD had designed and implemented the formative evaluation) and the fact that Principles of Technology pilot teachers were generally behind schedule in implementing units 8-14 meant that it was almost impossible to secure meaningful feedback concerning National Center suggestions for changes in the formative evaluation effort. The case studies being conducted by the AIT staff were in the pilot stage at the time data for this report had to be collected.

Assessment Summary

After sharing the proposed second-year formative evaluation approach with AIT project staff, AIT responded with a revised version of the data collection instruments (appendix E). The specific changes made by the AIT project staff are noted as follows.

o Student Reactionnaire

--Unit Objectives - Items 1, 2, and 3 were reworded.

--Unit Content - Items 5, 7, and 11 were deleted.

--Unit Posttest - Entire domain deleted.

--Unit Video - Items 16, 18, and 19 were deleted. Two items were added.

--Unit Text - No changes.

--Laboratory Activities - Items 26 and 27 deleted.

--Unit Difficulty - Item 30 deleted. Item 33 reworded.

--Student Satisfaction - Items 36 and 37 deleted. Item 38 reworded.

o Teacher Reactionnaire

--Unit Objectives - Items 2, 4, and 5 deleted.

--Unit Instructional Activities - Items 12 and 13 deleted.

--Unit Content - Items 14, 16, 17, and 18 deleted. One item added.

--Unit Posttest - Entire domain deleted.

--Perceptions of Instructional Planning - Item 35 deleted.

Furthermore, the student and teacher reactionnaires were renamed as student and teacher questionnaires. After each domain item set, a general comments statement was added. No substantive changes were made to the unit daily log and in the case study guidelines.

Case Studies

Information about the implementation of the case studies was based on a pilot test of the case study procedures by the AIT evaluation staff at a Principles of Technology site in a large local comprehensive secondary school.

Utility. The AIT evaluation staff considered the information collected through interviews, classroom observations, and document/record reviews to be very useful. The information collected added depth of understanding to that collected from the questionnaires. When data from the questionnaires and the case studies were combined, the data were generally more understandable and more logical. Considerable data were generated in the pilot case study. If the information is to be utilized optimally by curriculum developers, it will need to be reduced to a concise format that communicates significant points easily. It may be necessary to concentrate the case study effort in the early part of the curriculum field test so that feedback can be provided to curriculum developers in a timely manner.

Feasibility. Time and financial constraints are inherent difficulties in conducting case studies. National Center staff had suggested six case studies be conducted. Within the limits of time and finances, the AIT staff developed plans to complete four case studies. The time and cost of conducting the case studies was judged to be worthwhile, considering the high value placed on the information produced by the case studies. The case studies were particularly valuable in that they permitted evaluators to probe various interest groups and stakeholders who did not receive questionnaires.

Propriety. All sites and individuals involved in case studies were assured anonymity. No legal or ethical concerns were expressed by case study participants. The individuals conducting the case studies stressed the nature of formative evaluation, thereby lessening the potential for conflicts arising regarding the evaluation activities. The case studies provided an excellent opportunity to present strengths and weaknesses of the PT curriculum. Furthermore, the case studies allowed the evaluators the flexibility of being able to triangulate information on site.

Accuracy. At the time this report was written, none of the case study reports had been completed. Based on National Center staff knowledge of the PT effort and case study methodology, it appeared that the material to be developed for the case study reports reflected the reality of the situation in the local sites.

Developer implementation. The developer (AIT) plans to conduct four case studies. National Center staff has recommended six case studies because of the enormous variation in teacher background, student recruitment, availability of laboratory equipment, and local or State support. Time and financial constraints prevented the developer from conducting six case studies.

National Center staff considered it of vital importance for all of the individuals planning to conduct the case studies to be involved in a pilot case study so that the staff could reach consensus on topical areas to be studied and the emphasis to be placed on various aspects of the study, and, most importantly, could become more aware of the interpretations they place on various pieces of data. Two AIT staff who were to be responsible for conducting the case studies participated in a 5-day pilot of the case study procedures. The pilot effort enabled the two AIT staff members to reach agreement on most procedures and techniques to be used in succeeding case studies. Additional details were finalized through the use of telephone and mail communications.

Unit Daily Log, Teacher Questionnaire, and Student Questionnaire

Very few of the PT pilot sites completed all seven units scheduled for the first year. This meant that the first part of the second-year program, which should have been devoted to units 8-14, was devoted to units 6 and 7 in most situations. In order to maintain continuity, the same evaluation instruments used for units 1-7 during the first year of the PT pilot were used for units 6 and 7 that were taught during the second year of the PT pilot. The changes proposed by the National Center staff and adopted by AIT were to be used in the formative evaluation of units 8-14.

Because of the delays in starting unit 8 in most schools, there was minimal information available concerning implementation of the revised instruments at the time this report was written. The following information was obtained from AIT evaluation staff and local school site personnel who had completed unit 8.

Utility. The curriculum developers were generally pleased with the usefulness of information they received from the instruments. There may be some redundant information, but it was deemed important to have confirming information from students and teachers. The information was provided in a timely manner. Questionnaires completed by students and teachers were returned to the curriculum developers upon the completion of a PT unit. The timing difficulties appeared to be more a case of teachers not progressing through the units as rapidly as anticipated, rather than any difficulties associated with the formative evaluation of the curriculum.

Feasibility. National Center staff proposed several changes in the student questionnaire, teacher questionnaire, and the unit daily log. Earlier in this section, a summary was provided indicating AIT staff disposition of these suggestions. The changes in instrumentation were not perceived by teachers or students to be excessive in terms of classroom disruption. Teachers did indicate that completing the instruments was "a pain," but they understood and appreciated the need for such information. Teachers, administrators, and students were unaware of any problems caused by the evaluation. National Center staff did propose adding to the instruments a limited number of items dealing with teacher and instructional effectiveness as perceived by the students, however these items were eliminated by the AIT staff. A major shortcoming of the questionnaires was the lack of in-depth information about problems identified by the respondents. The case studies contribute substantially to correcting this situation by enabling AIT staff to collect in-depth information about PT curriculum problems. The cost of conducting the case studies has limited the number of sites and the time spent on-site, but the information gained from a limited number of case studies greatly enriches the formative evaluation data base.

Propriety. Respondents were assigned numbers, and AIT staff members exercised considerable caution in maintaining the anonymity of sites and individual respondents. Care was exercised so that excessive time would not be involved in completing the evaluation questionnaires. Open-ended questions allowed respondents the opportunity to identify strengths and weaknesses of the PT curriculum.

Accuracy. Administrators, teachers, and students were aware of and understood the purpose of the formative evaluation activities. As would be expected, some respondents were more enthusiastic than others regarding the evaluation activities, but there did not seem to be any threat to the accuracy of the evaluative responses. The formative evaluation objectives and activities were presented with sufficient clarity to permit their replication by other evaluators, should such a need arise.

Developer implementation. The AIT/CORD staff conducted a workshop for teachers designated to teach Principles of Technology. The evaluation activities and procedures were described during the workshop. In addition, teachers were mailed packets of questionnaires throughout the year. Each of these packets included explanatory material concerning the use of the instruments. Teachers were well-informed of the purposes of the formative evaluation and of the procedures for administering the questionnaires.

Conclusions concerning the formative evaluation of the Principles of Technology curriculum materials are presented in the following chapter. Recommendations are also presented regarding the planning and implementation of formative evaluation activities.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented in this report are based on task staff involvement with the formative evaluation of the Principles of Technology curriculum materials.

Assessment Conclusions

The following conclusions are based on (1) task staff involvement throughout the year with the formative evaluation of the Principles of Technology curriculum materials, (2) information collected from the ongoing AIT formative evaluation of the PT curriculum materials, and (3) information collected from AIT staff and local pilot site personnel as they were implementing the revised formative evaluation procedures and instruments.

- The AIT evaluation staff was receptive to suggestions for improving the formative evaluation effort, but it was extremely difficult or impracticable to make certain changes after the evaluation system had been operating for a full year.

- Individuals at State and local sites understood the need for the formative evaluation and were receptive to changes in the evaluation that would result in better information for curriculum revision. However, there is a limit to the amount of time that evaluators can reasonably expect local and State personnel to devote to evaluation purposes, particularly when teachers are a major source of evaluative information and also have the major responsibility for implementing a new curriculum.

- Among those individuals with the evaluation effort, there were no special concerns raised concerning legal, ethical, and common sense considerations.

- The most useful information collected by using the evaluation instruments came from open-ended questions addressed to teachers and students. The open-ended questions allowed teachers and students to explain why something was or was not working.

- The approach being used to evaluate the Principles of Technology curriculum materials provided a balance of positive and negative feedback to curriculum developers. The addition of case studies provided an opportunity for probing and in-depth description.

- In general, most individuals understood the major purpose of the formative evaluation and were willing to devote sufficient time so that the evaluation resulted in meaningful information for curriculum revision.

- The evaluation approach seemed to provide a sense of balance concerning the positive and negative aspects of the PT curriculum.

- The Principles of Technology curriculum was operating in complex and diverse settings. The formative evaluation approach did not provide sufficient information about the complexity of individual sites. The case studies partially remedied this situation, but their implementation did not occur until the second year of the field test of PT curriculum materials.

- It was probably a good public relations move to collect formative evaluation information from all PT sites. This enabled each State to develop a feeling of some ownership of the evaluation information. However, from the standpoint of cost and quality of data collected, it would have been more desirable to have used a small sample (e.g., one-third of sites) and do more in-depth probing at selected sites.

Recommendations for Formative Evaluation of Curriculum Efforts

The following recommendations are based on task staff involvement with the design for the formative evaluation of the Principles of Technology curriculum effort, previous evaluation efforts, and reviews of relevant literature.

- The designing of a formative evaluation effort should be done concurrently with the development of the curriculum and the development of strategies for field testing the curriculum.

- The purpose and nature of formative evaluation should be thoroughly explained for all concerned parties so that expectations for results do not overburden or undercut the evaluation effort.

- The information needed for curriculum revision should be clearly identified at the time the curriculum development is being planned so that sufficient consideration can be given to planning and implementing the evaluation effort.

- A combination of quantitative and qualitative data will most likely provide curriculum developers with the information they need for revision purposes.

- Evaluation procedures should be designed so that key individuals (e.g., students, teachers, and selected others) have an opportunity to provide information about the value of the curriculum.

- The curriculum developer/evaluator and the curriculum users (teachers, students) should make use of the telephone or other means that permit two-way communication. However, this should not be construed as an acceptable substitute for on-site, in-depth observations, interviews, and document/record reviews.

APPENDIX A
CONTENT REVIEW TEAM

CONTENT REVIEW TEAM

John Buschko
Technical Instructor
Intel Corporation
Chandler, AZ

Richard Cassel
Office of Press and Communications
Pennsylvania Department of Education
Harrisburg, PA

Joe Exline
Associate Director of Science
Virginia Department of Education
Richmond, VA

Darrell Parks, Director
Division of Vocational Education
Ohio Department of Education
Columbus, OH

Richard Patton
Coordinator of Instructional
  Materials Center
Oklahoma Department of Education
Stillwater, OK

Phillip Rollain
Project Coordinator
North Carolina Department of Public
  Instruction
Raleigh, NC

Don Torney
Superintendent of Youth Programming
TVOntario
Toronto, ON

Jim Wilson
Assistant Superintendent
Francis Tuttle Area VOTech Center
Oklahoma City, OK

APPENDIX B

FIRST-YEAR EVALUATION INSTRUMENTS

PRINCIPLES OF TECHNOLOGY
Instructional Package for Unit 3: RATE
Reviewer Questionnaire

SECTION I - STUDENT HANDBOOK

1. What did you like most about the student handbook? Why?

2. What did you like least about the student handbook? Why?

3. Is the student handbook written at the appropriate level for 11th and 12th-grade vocational students?

____ definitely ____ probably not
____ probably ____ definitely not

Comments:

4. Are the examples and illustrations used in the student handbook relevant to 11th and 12-grade vocational students?

____ definitely ____ probably not
____ probably ____ definitely not

5. Are there any errors or inaccuracies in the student handbook?

____ yes ____ no

If yes, please specify, including page number:

6. Is the content of the math labs useful for this unit?

____ definitely
____ probably
____ probably not
____ definitely not

7. Is the content of the hands-on-labs useful for this unit?

____ definitely
____ probably
____ probably not
____ definitely not

8. Do you have any other comments, concerns, or suggestions for the student handbook?

SECTION II - TEACHER'S GUIDE

1. Is the format of the teacher's guide (pages inserted next to the pertinent page of the student handbook) appropriate for the PRINCIPLES OF TECHNOLOGY course?

____ yes, definitely
____ yes, probably
____ no, probably not
____ no, definitely not

If no, what format modifications would you suggest?

2. Is the information presented in the teacher's guide accurate?

____ yes ____ no

If no, list inaccuracies including page numbers:

3. Will the teacher's guide enable a teacher to successfully implement the unit?

____ definitely	____ probably not
____ probably	____ definitely not
____ don't know	

If not, why not?

4. Do you have any other comments, concerns, or suggestions for the teacher's guide?

SECTION III - VIDEO PROGRAMS

1. Which video program did you like the most? Why?

2. Which video program did you like the least? Why?

3. Are the examples used in the video programs relevant to the 11th-and 12th-grade vocational students?

   ___ yes ___ no

   If no, list your concerns. Do you have suggestions for alternative examples? If so, please list below:

4. Are the examples used in the video programs useful for this unit?

   ____ yes ____ no

   If no, list your concerns and suggest alternative examples:

5. Is the content of the video programs accuurate?
____ yes ____ no

If no, list your concerns:

SECTION IV - OVERALL

6. Do the student handbook and video programs augment one another?

____ yes ____ no

Comments:

2. Will the materials (student handbook and video programs) increase students' understanding of RATE?

____ definitely ____ probably not

____ probably ____ definitely not

Comments:

3. Overall, how would you compare the RATE unit to units 1 and 2?

____ better ____ worse ____ about the same

If worse, why?

4. In terms of their overall impact (instructional effectiveness, student interest, teacher manageability) rank of each of the components of the RATE unti using the following scale:

A = Excellent
B = Good
C = So-so
D = Poor
E = Terrible

Place the letter, corresponding to your ranking, next to each component

____ Student Handbook

____ hands on labs

____ Video

____ teacher's guide

____ math labs

Please explain any C, D, or E rankings:

5. Do you have any other comments, concerns, or suggestions for the unit on RATE?

Name____

Consortium Agency____

PRINCIPLES OF TECHNOLOGY
UNIT 3: RATE
STUDENT ATTITUDE QUESTIONNAIRE

Sex: _____ Female _____ Male

Grade: _____ 9 _____ 10 _____ 11 _____ 12

1. Overall, did you like the unit on RATE?

   ____ yes, a lot ______ no, not very much
   ____ yes, a little ______ no, not at all

2. What component did you like most in the RATE unit?

   ____ the written material ______ the hands on labs
   ____ the video programs ______ no preference
   ____ the math labs

4. Overall, was the material that was covered in the RATE unit difficult for you to understand?

   ___ yes, most of the material was difficult for me to understand
   ___ yes, some of the material was difficult for me to understand
   ___ no, most of the material was not difficult for me to understand

5. Which component of the RATE unit was the most difficult for you to understand?

   ___ the written material ___ the hands on labs
   ___ the video programs ___ no component was particularly difficult
   ___ the math labs

7. Do you think the material in the RATE unit is important for you to understand?

   ___ yes, very important ___ no, not very important
   ___ yes, sort of important ___ no, not at all important

8. Do you have any comments about the RATE unit?

THANK YOU!

PRINCIPLES OF TECHNOLOGY
STUDENT BACKGROUND QUESTIONNAIRE

Grade: _____ 9 _____ 10 _____ 11 _____ 12

Sex: _____ Female _____ Male

1. What is your area of concentration in vocational education?

_____ electronics
_____ hydraulics/pneumatics
_____ auto mechanics
_____ woodworking
_____ agriculture/horticulture
_____ metal working
_____ general industrial arts
_____ other (please specify):

_____ am not in vocational education
_____ do not have an area of concentration

2. Which of the following math courses have you taken or are currently taking (check all that apply)?

_____ general math
_____ algebra
_____ geometry
_____ trigonometry
_____ calculus
_____ other (please specify):

3. Which of the following science courses have you taken or are currently taking (check all that apply)?

_____ physical science
_____ general science
_____ biology
_____ chemistry
_____ physics
_____ other (please specify):

4. What do you plan to do after high school?

_____ get a job
_____ go to a vocational school
_____ go to a junior college
_____ go to college
_____ I don't know

THANK YOU!

PRINCIPLES OF TECHNOLOGY
UNIT III: RATE
STUDENT TEST

1. In the unifying definition for rate, rate is the relationship between

   a. forcelike quantity and distance
   b. work and elapsed time
   c. displacementlike quantity and elapsed time
   d. voltage and charge

In the left column are rates that may or may not exist in one of the energy systems described in the right column. On your answer sheet fill in the letter of the energy system that corresponds to the numbered rate.

2. Mass flow (m/t)

3. Current (q/t)

4. Acceleration (v/t)

5. Heat flow per elapsed time (H/t)

6. Postal rate (cents/ounce)

7. Angular speed (0/t)

A. Rate in mechanical energy systems

B. Rate in fluid energy systems

C. Rate in electrical energy systems

D. Rate in thermal energy systems

E. Is not a rate in an energy system

8. When using the Internal System of units (SI), mechanical rate is measured in

   a. newton meters (N.m)

   b. newtons per second (N/s)

   c. feet per second (ft/s)

   d. meters per second (m/s)

9. Linear speed is

   a. distance an object travels along a line in a unit of time

   b. always expressed in SI units

   c. must include magnitude and direction

   d. measured in radians per second

10. Which of the following is a linear rate?

    a. helicopter blades in flight

    b. hands moving on a clock

    c. a jet airplane accelerating down a runway

    d. all of the above

11. Which of the following involves an angular rate?

    a. helicopter blades in flight

    b. ferris wheel

    c. hands moving on a clock

    d. all of the above

12. An increase in linear speed during an elapsed time is described as

    a. an average speed

    b. an acceleration

    c. a deceleration

    d. a new linear speed

13. Angular speed is

    a. always expressed in SI units

    b. measured in radians per unit of time

    c. distance an object travels along a line in a unit of time

    d. a vector quantity

14. When changed to radians per second, 4 RPM's is equal to (Note: Remember that 1 minute = 60 seconds and 2 radians = 360.

    a. 0.210 rad/sec

    b. 0.418 rad/sec

    c. 0.636 rad/sec

    d. 1.272 rad/sec

15. A unit of rate associated with a fluid system is

    a. gallons per minute

    b. kilograms per second

    c. cubic feet per minute

    d. all of the above

16. Volume flow rate is

    a. volume moved per unit of time

    b. determined by the length of the pipe

    c. always expressed in SI units

    d. a linear rate

17. A car air conditioner pumps 5 kg of freon gas through the system in 3 minutes. The mass flow rate of the freon gas is

    a. .60 kg/min

    b. 1.65 kg/min

    c. 15 kg/min

    d. not enough information given to calculate

18. One coulomb per second is a unit of

    a. electrical charge

    b. electrical voltage

    c. electrical current

    d. electrical resistance

An AC current changes direction at the rate of 120 times per second. Use this information to answer questions 19 and 20.

19. The frequency of the current is

    a. 1/120 cycles per second

    b. 1/60 cycles per second

    c. 120 cycles per second

    d. 60 cycles per second

20. The period of the current is

    a. 1/120 seconds

    b. 1/60 seconds

    c. 120 seconds

    d. 60 seconds

21. When an ammeter is placed in a circuit to measure current through a resistor, it is placed in __________ with the resistor

    a. series

    b. parallel

    c. at right angles

    d. none of the above

22. The term 60 Hz is an electrical

    a. period

    b. frequency

    c. event

    d. amplitude

23. Rate in an electrical system is

    a. how fast charge flows through a conductor in a unit of time

    b. electrical current in coulombs

    c. only measured in DC current

    d. all of the above

24. Heat flow rate is

a. calories per second

b. BTUs per minute

c. heat energy per unit of time

d. all of the above

25. In the English system, heat flow rate is stated in

a. calories/second

b. joules/second

c. BTUs/hour

d. all of the above

26. The amount of heat energy required to raise the temperature of a given body one degree is

a. latent heat

b. heat capacity

c. specific heat

d. sensible heat

27. How many units of heat energy are required to raise a unit mass a unit temperature difference defines

a. latent heat

b. heat capacity

c. specific heat

d. sensible heat

28. The heat capacity of 10 pounds of water is

a. 10 cal/C

b. 1 BTU/F

c. 10 BTU/hr

d. 10 BTU/F

29. The calories per second of heat energy flowing through a window pane does not depend on

    a. thickness of glass

    b. weight of the glass

    c. surface area of the glass

    d. type of glass

30. Water at 90 C to steam at 100 C is

    a. latent heat

    b. sensible heat

    c. both latent and sensible heat

    d. specific heat

PRINCIPLES OF TECHNOLOGY
TEACHER PERCEPTIONS OF STUDENT CHARACTERISTICS

1. How many students are in your PRINCIPLES OF TECHNOLOGY class?

2. Have you had any of these students in classes other than PRINCIPLES OF TECHNOLOGY? _____ yes _____ no

   If yes, which classes?

3. Are the students in your PRINCIPLES OF TECHNOLOGY class all from one school district? _____ yes _____ no

   If no, how many school districts do they come from?
   _____ 2 _____ 3 _____ 4 _____ 5 _____ more than 5

4. Please briefly describe how students were selected for your PRINCIPLES OF TECHNOLOGY class:

5. What is the ability level of your students? Please indicate the approximate number of students in each category:

   _____ above average _____ average _____ below average

   Comments:

6. What is the socioeconomic level of your students? Please indicate the approximate number of students in each category:

   _____ upper class
   _____ upper middle class
   _____ middle class
   _____ lower middle class
   _____ lower

7. What is the racial/ethnic composition of the class? Please specify the number of each:

   _____ White
   _____ Black
   _____ Hispanic
   _____ Oriental
   _____ American Indian
   _____ Other (please specify):

8. Please detail any other information about your class that you feel is pertinent.

PRINCIPLES OF TECHNOLOGY
UNIT III: RATE
TEACHER QUESTIONNAIRE

1. What did you like most about the RATE unit?

2. What did you like least about the RATE unit?

3. Overall, how would you compare the RATE unit to units 1 and 2?

_____ better _____ about the same _____ worse

If worse, why?

4. In terms of their overall impact (instructional effectiveness, student interest, manageability) rank each of the components of the RATE unit using the following scale:

A = Excellent
B = Good
C = So-so
D = Poor
E = Terrible

Place the letter, corresponding to your ranking, next to each component.

_____ student handbook
_____ videos
_____ math labs
_____ hands on labs
_____ teacher's guide

Please explain any C, D, or E rankings and/or list any other comments you have about the components:

5. Which of your students seem to be the most successful in the PRINCIPLES OF TECHNOLOGY course?

_____ above _____ average _____ below average

6. Based on your experiences, do you think the 6-day plan, per subunit, of 50-minute class sessions is realistic for the subunits?

_____ yes, definitely
_____ yes, probably
_____ no, probably not
_____ no, definitely not

If no, please explain:

7. On average, how much time did you spend preparing to teach each class in the unit on RATE?

_____ 0-30 minutes
_____ 31-60 minutes
_____ 61-90 minutes
_____ 91-120 minutes
_____ 121-180 minutes
_____ 181 or more minutes

Comments:

8. Overall, did you feel comfortable teaching the materials in the unit on RATE?

_____ yes, very comfortable
_____ yes, sort of comfortable
_____ no, not very comfortable
_____ no, not at all comfortable

If no, please specify:

9. Do you think most of your students did the assigned readings at home?

_____ definitely _____ probably _____ probably not
_____ definitely not

Comments:

10. What, if anything, caused you the most problems in teaching the unit on RATE?

11. Do you feel the Teacher's Guide material provided you with enough information to help you successfully implement the unit?

12. Did you teach Unit III: RATE on consecutive days for 26 days?

_____ yes _____ no

If no, what pattern did you use (for example, 3 days a week)?

13. How much time per session did you teach?

_____ 50 minutes or less
_____ 51-60 minutes
_____ 61-90 minutes
_____ 91+ minutes

14. Did you combine any classes into one session (for example, teach classes C1 and C2 in one session)?

_____ yes _____ no

If yes, which classes did you combine?

15. How many physics courses did you take in college (undergraduate and graduate)?

_____ none
_____ 1
_____ 2-4
_____ 5-7
_____ 8 or more

16. How many math courses did you take in college (undergraduate and graduate)?

_____ none
_____ 1
_____ 2-4
_____ 5-7
_____ 8 or more

17. Do you have any other comments, concerns, or suggestions for the unit on RATE?

The following chart lists each activity for the unit on RATE down the left column. Since there are no materials specifically for the sub-unit review classes, these classes have not been listed in the chart. For each activity, you should respond to the following questions by circling "yes" or "no":

1. Was the material (readings, labs, or videos) appropriate for your students? Was the material at the right grade level? Was the amount of material appropriate for your students? For any no responses, please use the attached pages to describe your concerns.

2. Were you able to cover the material to your satisfaction in the 50-minute time period? (Since this question doesn't apply to the video, no response options have been provided for the column. Please do respond, however, to the other questions about the video.) For any no responses, please use the attached pages to describe why you could not complete the material and/or what you chose to delete.

3. Were there any errors or inaccuracies in the material? For any yes responses, use the attached pages to specify the errors and recommended corrections.

4. Were there any problems managing the activity? For the labs, were all your students able to rotate through the labs? Did you experience any problems coordinating the labs? Did you experience any problems setting up or tearing down the labs? Did you experience any problems coordinating the activity? For any yes responses, use the attached pages to specify the problems you had and, if possible, suggest changes that you feel would enable you to more easily manage the material.

5. Do you have any suggested modifications for the material? For any yes responses, use the additional pages to specify your suggestions. Include in this section any "teaching tips"--special procedures you used or means you discovered to more easily convey the information to students. Include in this section any comments you may have for the Teacher's Guide.

We recommend that you take a few minutes each day to complete the chart and, most importantly, to write down your comments. If you need more space for comments, use the back of the comments Wages and/or attach additional sheets.

UNIT III: RATE

	Appropriate for students?	Completed in 50 minutes?	Any errors or inaccuracies?	Any management problems?	Any suggested modifications?
Overview Video	yes no	—— —	yes no	yes no	yes no
C0	yes no	yes no	yes no	yes no	yes no
Mechanical Systems					
Video	yes no	—— —	yes no	yes no	yes no
C1	yes no	yes no	yes no	yes no	yes no
C2	yes no	yes no	yes no	yes no	yes no
Math Lab	yes no	yes no	yes no	yes no	yes no
3M1	yes no	yes no	yes no	yes no	yes no
3M2	yes no	yes no	yes no	yes no	yes no
Fluid Systems					
Video	yes no	—— —	yes no	yes no	yes no
C1	yes no	yes no	yes no	yes no	yes no
C2	yes no	yes no	yes no	yes no	yes no
Math Lab	yes no	yes no	yes no	yes no	yes no
3F1	yes no	yes no	yes no	yes no	yes no
3F2	yes no	yes no	yes no	yes no	yes no
Electrical Systems					
Video	yes no	—— —	yes no	yes no	yes no
C1	yes no	yes no	yes no	yes no	yes no
C2	yes no	yes no	yes no	yes no	yes no

UNIT III (continued)

Math Lab	yes no	yes no	yes no	yes no	yes no
3E1	yes no	yes no	yes no	yes no	yes no
3E2	yes no	yes no	yes no	yes no	yes no
Thermal Systems					
Video	yes no	--- --	yes no	yes no	yes no
C1	yes no	yes no	yes no	yes no	yes no
C2	yes no	yes no	yes no	yes no	yes no
Math Lab	yes no	yes no	yes no	yes no	yes no
3T1	yes no	yes no	yes no	yes no	yes no
3T2	yes no	yes no	yes no	yes no	yes no
Summary					
Video	yes no	yes no	yes no	yes no	yes no

Comments for Overview Class

Comments for Videos

Overview Video:

Mechanical Systems Video:

Fluid Systems Video:

Electrical Systems Video:

Thermal Systems Video:

Summary Video:

Comments for Cl Classes

Mechanical Systems Cl:

Fluid Systems Cl:

Electrical Systems Cl:

Thermal Systems Cl:

Comments for C2 Classes

Mechanical Systems C2:

Fluid Systems C2:

Electrical Systems C2:

Thermal Systems C2:

Comments for Math Lab Classes

Mechanical Systems Math Lab:

Fluid Systems Math Lab:

Electrical Systems Math Lab:

Thermal Systems Math Lab:

Comments for Lab 1 Classes

Mechanical Systems Lab 1:

Fluid Systems Lab 1:

Electrical Systems Lab 1:

Thermal Systems Lab 1:

Comments for Lab 2 Classes

Mechanical Systems Lab 2:

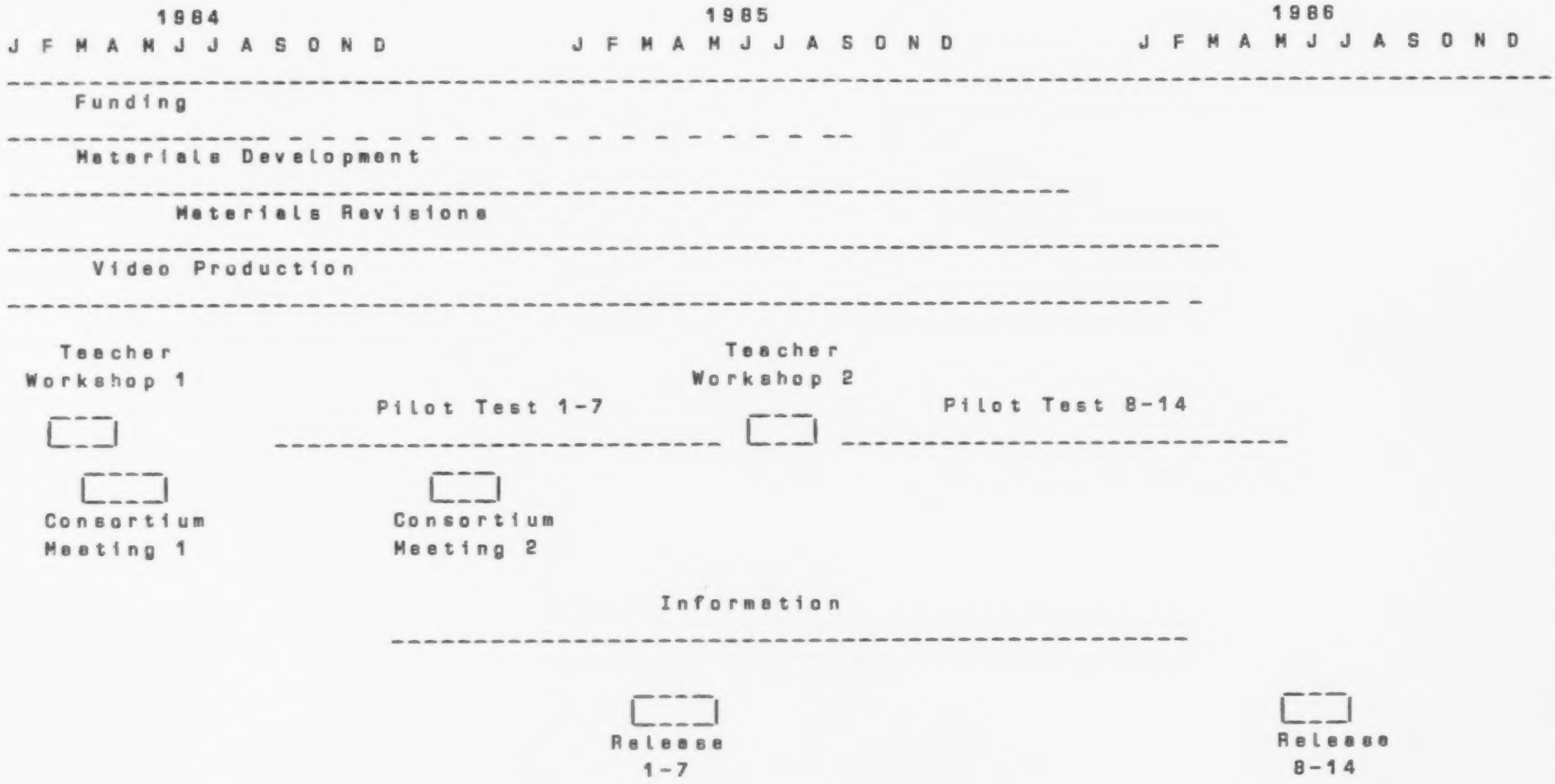
Fluid Systems Lab 2:

Electrical Systems Lab 2:

Thermal Systems Lab 2:

APPENDIX C

FORMATIVE EVALUATION TIME LINE


1984
J F M A M J J A S O N D
1985
J F M A M J J A S O N D
1986
J F M A M J J A S O N D
Funding
Materials Development
Materials Revisions
Video Production
Teacher Workshop 1
Pilot Test 1-7
Teacher Workshop 2
Pilot Test 8-14
Consortium Meeting 1
Consortium Meeting 2
Information
Release 1-7
Release 8-14

APPENDIX D

THE NATIONAL CENTER SUGGESTED APPROACH FOR THE SECOND-YEAR FORMATIVE EVALUATION

Unit Number _____

PRINCIPLES OF TECHNOLOGY UNIT EVALUATION
STUDENT REACTIONNAIRE

PURPOSE:

Your answers to the questions on this form will help improve this Principles of Technology unit for other students. Your responses to the following items are appreciated.

DIRECTIONS:

Below are a list of statements. Please read each statement and answer whether you strongly agree, agree, disagree, or strongly disagree by checking the appropriate box. Place a check mark ( ) in only one box for each statement.

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT OBJECTIVES				
For this unit:				
(1) The objectives were clear on what I was to learn	( )	( )	( )	( )
(2) I knew what I needed to do to achieve the objectives	( )	( )	( )	( )
(3) I knew when I had achieved a unit objective.	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
(4) What I learned and what I was supposed to learn (as stated by the objectives) were different	( )	( )	( )	( )
UNIT CONTENT				
The content of this unit:				
(5) Was presented in a logical order. . . .	( )	( )	( )	( )
(6) Had too much information	( )	( )	( )	( )
(7) Used language difficult for me to understand	( )	( )	( )	( )
(8) Gave examples helpful in understanding major concepts	( )	( )	( )	( )
(9) Was difficult for me to understand. . . .	( )	( )	( )	( )
(10) Will probably be useful in future jobs . . .	( )	( )	( )	( )
(11) Did not have enough examples	( )	( )	( )	( )
UNIT POSTTEST				
The posttest questions:				
(12) Were covered in the unit instruction . .	( )	( )	( )	( )
(13) Were clearly stated	( )	( )	( )	( )
(14) Sampled important points in the unit	( )	( )	( )	( )
(15) Were generally fair	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT VIDEO				
The video programs for this unit:				
(16) Supported the text material	( )	( )	( )	( )
(17) Used easy to understand graphics . .	( )	( )	( )	( )
(18) Used language difficult for me to understand	( )	( )	( )	( )
(19) Used theme music that I liked.	( )	( )	( )	( )
UNIT TEXT				
The unit text materials:				
(20) Helped me to achieve the unit objectives	( )	( )	( )	( )
(21) Will be a useful reference after taking the course	( )	( )	( )	( )
(22) Used language difficult				
(23) Had enough examples to help me understand the important concepts	( )	( )	( )	( )
LABORATORY ACTIVITIES				
The unit lab activities:				
(24) Helped me to achieve the unit objectives	( )	( )	( )	( )
(25) Were difficult . .	( )	( )	( )	( )
(26) Should not include math labs.	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
(27) Take too long to set up the equipment	( )	( )	( )	( )
(28) Time periods were not long enough to complete the work	( )	( )	( )	( )
(29) In general, were well like.	( )	( )	( )	( )
UNIT DIFFICULTY				
For this unit:				
(30) I did not have enough time to do my work.	( )	( )	( )	( )
(31) Some of the things the teacher wanted me to learn were just too hard . .	( )	( )	( )	( )
(32) I had trouble reading the unit text materials. .	( )	( )	( )	( )
(33) The teacher gave me too much work to do	( )	( )	( )	( )
STUDENT SATISFACTION				
For this unit:				
(34) I usually had a sense of satisfaction after leaving class each day.	( )	( )	( )	( )
(35) I did not like coming to class	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
(36) My classmates felt good about what happened in class	( )	( )	( )	( )
(37) I felt good about what happened in class	( )	( )	( )	( )
(38) I would not recommend it to my friends	( )	( )	( )	( )

Unit Number:______

PRINCIPLES OF TECHNOLOGY UNIT EVALUATION:
TEACHER REACTIONNAIRE

PURPOSE:

The primary purpose of this reactionnaire is to provide teacher information for facilitating improvement of the Principles of Technology curriculum. Specifically, this form is designed to assess the appropriateness of Principles of Technology unit objectives and the appropriateness of instructional activities, resources, curriculum content, posttests, and instructional planning needed to accomplish these objectives.

DIRECTIONS:

Below are a list of statements. Please read each statement and answer whether you strongly agree, agree, disagree, or strongly disagree by checking the appropriate box. Place a check mark ( ) in only one box for each statement.

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT OBJECTIVES				
The unit objectives:				
(1) assist me in assessing student progress . . .	( )	( )	( )	( )
(2) The unit objectives are difficult for me to use.	( )	( )	( )	( )
(3) don't reflect what the unit is designed to teach	( )	( )	( )	( )
(4) assist students in knowing what is expected of them . . .	( )	( )	( )	( )
(5) are worded too simplistic to be of value	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
(6) help me determine what to teach.	( )	( )	( )	( )
(7) are presented in a logical order.	( )	( )	( )	( )

UNIT INSTRUCTIONAL ACTIVITIES

The unit instructional activities:

(8) are related to unit objectives	( )	( )	( )	( )
(9) require more than one instructor to teach the unit content . . .	( )	( )	( )	( )
(10) are presented in the correct sequence	( )	( )	( )	( )
(11) require a reading level that is too difficult for most students	( )	( )	( )	( )
(12) do not have enough math labs.	( )	( )	( )	( )
(13) take too much time for most students to complete	( )	( )	( )	( )

UNIT CONTENT

The unit content:

(14) was presented in a logical order.	( )	( )	( )	( )
(15) was too detailed . . .	( )	( )	( )	( )
(16) was too easy	( )	( )	( )	( )
(17) was just right	( )	( )	( )	( )

	Strongly Agree	Agree	Disagree	Strongly Disagree
(18) used language that was difficult for most students to understand	( )	( )	( )	( )
(19) contained examples that were helpful to students in their understanding of unit concepts.	( )	( )	( )	( )
(20) contained enough examples	( )	( )	( )	( )
(21) provided enough summaries of important points	( )	( )	( )	( )
(22) provided information that will be useful for students in their future employment. . .	( )	( )	( )	( )

UNIT POSTTEST

The unit posttest questions:

(23) asked different things than what had been taught	( )	( )	( )	( )
(24) were clearly worked. .	( )	( )	( )	( )
(25) covered all the important point in the unit	( )	( )	( )	( )
(26) were generally fair. .	( )	( )	( )	( )

PERCEPTIONS OF INSTRUCTIONAL PLANNING

(27) How many paid hours of planning (e.g., planning periods, after school) did you receive for planning and preparing materials for this unit?
Number of hours______

Is this amount of time adequate?
( ) Yes
( ) No, I need ____ additional hours.

(28) Approximately how much time did you expect students to spend on homework each day for this unit?

( ) None
( ) About half an hour
( ) About one hour
( ) About two hours
( ) More than two hours

(29) What percentage of students typically completed your homework assignments for this unit?

( ) Fewer than 25%
( ) 26% to 49%
( ) 50% to 74%
( ) 75% and above

(30) Do you feel the Teacher's Guide material provided you with enough information to help you teach the unit?

( ) Definitely ( ) Probably ( ) Probably not ( ) Definitely

(31) Did you teach this UNIT on consecutive days for 26 days?

( ) Yes ( ) No

If no, what pattern did you see (for example, 3 days a week)?

(32) How much time per class section did you devote to this UNIT?

( ) 50 minutes or less
( ) 51-60 minutes
( ) 61-90 minutes
( ) 91+ minutes

(33) Did you combine any of the unit's classes into one session (for example, teach classes C1 and C2 in one session)?

( ) Yes ( ) No

If yes, which classes did you combine?

(34) Based on your experiences, do you think the 6-day plan, per sub-unit, of 50-minute class sessions is realistic for this Unit?

( ) Yes, definitely

( ) Yes, probably

( ) No, probably not

( ) No, definitely not

(35) On average, how much time did you spend preparing to teach each class in this Unit?

( ) 1/4 hour

( ) 1/2 hour

( ) 3/4 hour

( ) 1 hour

( ) 1 1/2 hours

( ) 2 hours or more

Comments:

(36) Overall, did you feel comfortable teaching the materials in this UNIT?

( ) Yes, very comfortable
( ) Yes, sort of comfortable

( ) No, not very comfortable
( ) No, not at all comfortable

If no, please explain:

(37) What, if anything, caused you the most problems in teaching this UNIT?

(38) What did you like the most in teaching this UNIT?

UNIT_______________

PRINCIPLES OF TECHNOLOGY
UNIT DAILY LOG

PURPOSE:

The purpose of the Unit Daily Log is to provide a continuous source of teacher information for improving the Principles of Technology curriculum.

DIRECTIONS:

The left column on the following charts list each activity for this particular unit. Since there are no materials specifically for the sub-unit review classes, these classes have not been listed in the chart.

For columns 1-5 on the attached charts:

(1) Circle "Y" (yes) or "N" (No): Were the reading, labs, or videos appropriate (e.g., grade level, sufficient quantity of material) for your students? If not, specify modifications in column 5.

(2) Circle "Y" (yes) or "N" (No): Were you able to cover the content in the 50-minute time period?

(3) Briefly describe any errors or inaccuracies in the material.

(4) Briefly describe any problems you had in managing the material. Among others, this may include problems in coordinating lab rotations, lab set-up, and maintaining student interest.

(5) Briefly list suggestions for modifying the material. Describe "teaching tips" for future teachers.

We recommend that you take a few minutes each day to complete the charts. If you need more space for comments, use the back of the charts and/or attached additional pages.

Unit	[1] Appropriate for students?	[2] Completed in 50-60 minutes?	[3] Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	[4] Did you have any management problems? If so, please specify in the appropriate spaces below.	[5] Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
OVERVIEW					
Video	Y N				
C0	Y N	Y N			
MECHANICAL SYSTEMS					
Video	Y N				
C1	Y N	Y N			
C2	Y N	Y N			
Math Lab	Y N	Y N			
MF1	Y N	Y N			

Unit	(1) Appropriate for students?	(2) Completed in 50-60 minutes?	(3) Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	(4) Did you have any management problems? If so, please specify in the appropriate spaces below.	(5) Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
MF2	Y N	Y N			
Video	Y N				
C1	Y N	Y N			
C2	Y N	Y N			

Unit	(1) Appropriate for students?	(2) Completed in 50-60 minutes?	(3) Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	(4) Did you have any management problems? If so, please specify in the appropriate spaces below.	(5) Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
Math Lab	Y N	Y N			
MF3	Y N	Y N			
MF4	Y N	Y N			
Video	Y N				

Electrical Systems	(1) Appropriate for students?	(2) Completed in 50-60 minutes?	(3) Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	(4) Did you have any management problems? If so, please specify in the appropriate spaces below.	(5) Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
C1	Y N	Y N			
C2	Y N	Y N			
Math Lab	Y N	Y N			
E1	Y N	Y N			
E2	Y N	Y N			

Thermal Systems	(1) Appropriate for students?	(2) Completed in 50-60 minutes?	(3) Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	(4) Did you have any management problems? If so, please specify in the appropriate spaces below.	(5) Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
Video	Y N				
C1	Y N	Y N			
C2	Y N	Y N			
Math Lab	Y N	Y N			
T1	Y N	Y N			
T2	Y N	Y N			

Thermal Systems	[1] Appropriate for students?	[2] Completed in 50-60 minutes?	[3] Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	[4] Did you have any management problems? If so, please specify in the appropriate spaces below.	[5] Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
Summary Video	Y N				

CASE STUDIES

PRINCIPLES OF TECHNOLOGY

Setting Boundaries

The primary purpose of the case studies is to provide information for facilitating improvement in the Principles of Technology curriculum. In view of the primary purpose of the case studies the investigation will be limited to secondary school sites participating in the Principles of Technology project. The major focus at the secondary school site will be the Principles of Technology class.

Selecting Sites

Purposeful sampling is to be done in selecting the sites. Six sites will be studied. In order to achieve a wide variety of conditions, sites will be selected according to the following criteria:

- exceptionally good programs
- typical programs
- geographical variation
  - areas of the country
  - rural, urban, suburban
- programs serving special needs groups
- convenience

Caution will be exercised by not selecting politically sensitive sites.

Establishing Initial Contacts

Once sites have been selected, appropriate approvals will be secured. The protocol network will be followed in securing approval to conduct the case studies. While the protocol may vary by state, in general, the procedure will involve the following:

- state agency approval
- local agency approval
- local teacher approval

Confidentiality will be assured with regard to the identification of state and local sites and individuals.

Developing Data Collection Procedures

Data will be collected by:

- Interviews - The interviews are designed to provide in-depth qualitative descriptions of Principles of Technology teacher, student, and administrator perceptions on the following topics: objectives, content, learner activities, teacher knowledge, and instructional techniques, posttests, instructional aids, equipment and materials, and an overall assessment of the Principles of Technology curriculum. In addition, where appropriate, interviews will be conducted with representatives of business/industry and members of citizen advisory committees.

- o Observations - The observations are designed to provide in-depth qualitative descriptions of Principles of Technology classroom instruction.

- o Document/Record Reviews - The reviews of printed or written accounts should provide a picture on a stronger contextual basis for what has happened in the Principles of Technology classes.

- o Analysis of Extant Data - The analysis of information from the student reactionnaire, teacher reactionnaire, the unit daily log, pretests, and posttests provides additional data input for the case studies.

Potential Topics and Subtopics for Guiding Interviews, Observations, Document/Record Reviews and Data Recording Categories

These topics and subtopics can be used for focusing interviews, observations, document/record reviews, and the analysis of extant data. They can also serve as a framework for coding the data collected.

I. Objectives

  A. Clarity of meaning
  B. Clarified what was to be learned
  C. Appropriate coverage of objective in affective, psychomotor, cognitive and perceptual domains
  D. Level of difficulty of objectives within each domain

II. Content

  A. Logical order
  B. Correct level of difficulty (depth)
  C. Adequacy of amount of information
  D. Appropriate language level
  E. Meaningful examples
  F. Sufficient examples
  G. Clarity of directions
  H. Relevant

III. Learner Activities

A. Relevancy to objectives and content
B. Appropriately sequenced
C. Appropriate number
D. Efficient use of time
E. Problems created

IV. Teacher

A. Adequacy of knowledge
B. Effectiveness of instructional techniques
C. Quick response to questions
D. Availability to help
E. Quality of student-teacher interaction

V. Posttest

A. Covered important points
B. Clearly worded
C. Fair

VI. Instructional Aids

A. Appropriate for objectives and content
B. Reinforced concepts
C. Interesting

VII. Equipment and Materials

A. Appropriate for objectives and content
B. Difficulty of use
C. Safety problems
D. Difficult to locate
E. Reasonable cost
F. Complexity of construction and/or fabrication
G. Instruction time required

VIII. General

A. What did you like most about course?
B. What did you dislike most about course?
C. Were parts of course boring?
D. Were parts of course confusing?
E. Amount of homework
F. Any additional comments about course?

DESCRIPTION OF TOPICS AND SUBTOPICS
(INTERVIEWS)

I. Objectives

Since the steps of the Principles of Technology instructional development process are driven by unit objectives, the first task is to determine the adequacy of these objectives. Interviews with teachers can provide reliable information about the appropriateness of the unit objectives in addition to providing evidence as to their worth.

Specifically, teachers can provide useful information about the objectives' clarity of meaning. For instance, did the teachers and students understand the objectives? Do the objectives accurately reflect what the student is supposed to do or know? Can the objectives be operationalized? Moreover, teachers can determine if the unit objectives appropriately covered the affective, psychomotor, and cognitive domains. Teachers can also provide use~~ful in~~sights about the level of difficulty of the objectives within each of these domains. In sum, interviews with Principles of Technology teachers should, in part, focus on obtaining information that can be used to judge the adequacy of unit objectives.

II. Content

During the teacher interviews, information about the content of each Principles of Technology unit should be obtained. Teachers can provide useful content analysis input about the appropriateness of each unit. For example, it would be useful to know if the teachers believe that the unit content is presented in a logical order. Moreover, do the teachers believe that the unit is at the correct level of difficulty? Is the language level of the units adequate? Insights to the adequacy of unit examples, graphics, and clarity of directions would also assist in the verification of unit content.

III. Learner Activities

During the teacher interview, information about the relevancy of the learning activities to unit objectives and content should be obtained. Are the math and hands-on laboratory activities appropriately sequenced? Are the number of learning activities appropriate? The teachers should be permitted to express their opinions about the effectiveness of the learning activities. Were the activities an efficient use of time? What classroom management problems did the teachers encounter with the learning activities? Teacher suggestions for improving the learning activities for each unit should also be obtained.

IV. Teacher

The teachers should be asked to comment on their knowledge of the unit subject matter. Is their knowledge adequate to teach the material? Teachers should be asked to comment on the effectiveness of the instructional techniques that are suggested in the teacher's guide. Moreover, given the math and hands-on laboratory activities, can the teachers respond quickly to student questions? Likewise, during the laboratory activities, are teachers able to give sufficient individual student help?

V. Posttest

Teachers should be asked if the posttest covered the important points of the unit. Did the posttest ask different things from what had been taught? Were the posttest items clearly worded and were the items fair? Suggestions for improving the posttest should be obtained.

VI. Instructional Aids

Information about the appropriateness of the instructional aids should be obtained during the teacher interview. Were the aids appropriate for the objectives and content? Did the video, student workbook, math exercises, and lab demonstrations reinforce unit concepts? Did the instructional aids maintain student interest? Suggestions for improving instructional aids should be obtained.

VII. Equipment and Materials

Information about the appropriateness of laboratory equipment and instructional materials should be obtained during the teacher interview. Were the equipment and materials appropriate for accomplishing unit objectives? What procedural or management problems did the teachers encounter with the equipment and materials? Ask the teachers to note any safety problems they discovered with the equipment. Were needed equipment and laboratory materials available when it came time to use them? Information on the complexity of constructing laboratory set-ups and/or fabricating laboratory materials would be helpful in determining the difficulty of equipment and material use. Is the cost reasonable for unit equipment and materials? Was the time allotted for instruction sufficient to accomplish laboratory learning activities?

VIII. General

During the interview, teacher perceptions of what they liked and disliked most about the unit/course should be obtained. Teachers should note what parts of the unit/course were boring and confusing. Was the amount of homework required sufficient? Did students do their homework? Teachers should be permitted to make any additional comments about the unit or course as they see fit.

DESCRIPTION OF TOPICS AND SUBTOPICS
(OBSERVATIONS)

I. Objectives

During the classroom observation, observer impressions of unit objectives should be noted. Did the students understand the importance of the objectives? Were the objectives clear as to what the students were supposed to do or learn? The observer should note if there was an appropriate coverage of objectives in the affective, psychomotor, and cognitive domains. Furthermore, within each of these domains, were the objectives appropriate as to their level of difficulty? Observer impressions of the usefulness of unit objectives in enhancing classroom learning should be noted.

II. Content

Observer impressions of the unit content should be noted. Specifically, did the unit appear to be at the correct level of difficulty? Did the language level appear to be appropriate for the majority of the students? Was the amount of information contained in the unit adequate? The observer should try to get a feel for the appropriateness of unit examples. Did the examples appear to be sufficient and meaningful? Moreover, did the students appear to understand directions that were stated by the teacher? Insights on the clarity of student workbook directions would be helpful as well.

III. Learner Activities

Observer impressions on the relevancy of learning activities to objectives and unit content should be noted. Were the learning activities appropriately sequenced? Were there an appropriate number of activities planned? The observer should also note whether the learning activities were an efficient use of time. What problems did the instructor and students encounter during the learning activities that were observed?

IV. Teacher

Did the instructor appear to have an adequate amount of knowledge of the subject area? Observer impressions of instructor's instructional techniques should be noted. Was the instructor able to respond quickly to student questions? Was the instructor available to help all students who needed help? Overall impressions of the instructor's command of the class may also be noted.

V. Posttest

Specifically, the observer should attempt to determine if the unit posttest covered important points taught in class. Observer impressions of whether the posttest is fair and clearly worded should also be noted.

VI. Instructional Aids

Impressions of whether the instructional aids (video, graphics, math problems) are appropriate for unit objectives and content should be noted. Are the students interested in the instructional aids? Do the instructional aids appear to reinforce unit concepts? The observer should note any problems the students or teachers encountered when using the instructional aids.

VII. Equipment and Materials

Observer impressions of the laboratory equipment and materials should be noted. Specifically, the observer should note if the equipment and materials are appropriate for unit objectives and content. Were the lab equipment and materials easy to set up and use by the students and teachers? The observer should note any safety problems that the equipment and materials may cause. Moreover, was the instruction time allotted for the laboratory activities sufficient? Overall impressions of the lab activities would be welcome.

VIII. General

Overall impressions of the classroom observation should be noted. What did the students like best about the unit? What did the students dislike most about the unit? Did the teacher or students appear to be interested? Were they bored? What parts of the unit did the students and teachers appear to find most interesting? Did the teacher or students become confused during the instruction period? If so, what caused the confusion? Any additional comments that the observer has about the classroom observation should be noted.

DESCRIPTION OF TOPICS AND SUBTOPICS
(DOCUMENT/RECORD REVIEWS)

I. Objectives

Included in the document/record review should be the reviewer's impressions of the unit objective development process. Specifically, were the objectives developed by those knowledgeable about the subject matter needed by secondary vocational education students? Did the objective development process ensure that an appropriate coverage of unit objectives was included in the affective, psychomotor, and cognitive domains? Moreover, within each of these domains, were the objectives developed at an appropriate level of difficulty? Development procedures designed to clarify the meaning of each objective and the criteria used to determine what the student needs to know should be noted.

II. Content

The reviewer should examine content development procedures designed to ensure that unit content is presented in a logical order and at the correct level of difficulty and language level. What rationale did the developers follow to determine the adequacy of the amount of unit information? Reviewer impressions of each unit's clarity of directions, meaningfulness of unit examples, and the number of examples should be noted. In sum, what procedures did the curriculum developer follow to ensure appropriate unit content?

III. Learner Activities

The reviewer should examine the learning activity development process. What steps were taken by the developer to ensure that learner activities are relevant to unit objectives and content? Documentation that provide evidence that the learner activities are appropriately sequenced, are of an appropriate number, and are an efficient use of time should be noted. Records that indicate problems encountered by learner activities should be noted as well.

IV. Teacher

Records pertaining to teacher background should be reviewed. Do the teachers have adequate knowledge to teach Principles of Technology? Moreover, what evidence exists that teachers make effective use of instructional techniques?

V. Posttest

The reviewer should examine procedures used in developing posttest items. What steps did the developer take to ensure that posttest items covered important unit points, that items are clearly worded, and that items are fair? In sum, are the unit posttests valid representations of unit content?

VI. Instructional Aids

The reviewer should examine the instructional aid development process. Were steps taken by the developer to ensure that instructional aids are appropriate for unit objectives and content? Evidence that the instructional aids reinforce unit concepts and are interesting to the students and teachers should be noted.

VII. Equipment and Materials

The reviewer should ascertain whether the equipment and materials are appropriate for unit objectives and content. Specifically, records pertaining to difficulty of use, safety problems, availability, cost, construction complexity, and time required for effective instruction should be examined.

VIII. General

After reviewing documents and records pertaining to the Principles of Technology development process, the reviewer is encouraged to make general comments about the curriculum. For example, what did the reviewer like and dislike most about the curriculum? What parts of the units were boring or confusing? What is an appropriate amount of homework? The reviewer should feel free to make additional comments, specific or general, about the curriculum or the curriculum development process.

(SAMPLE)
INTERVIEW NOTE SHEET

SITE: ______________________
DATE: ______________________
TIME: ______________________
INTERVIEWER: ______________________

INTERVIEWEE:
NAME: ______________________
TITLE: ______________________
ORG.: ______________________
STREET: ______________________
CITY: ______________________
ZIP: ______________________
TELEPHONE: ______________________

INTERVIEW NOTES

CODE	NARRATIVE

SITE: ______________________
TEACHER: ______________________
CLASS: ______________________
OBSERVER: ______________________
DATE: ______________________

CLASSROOM OBSERVATIONS

OBSERVATIONS (NARRATIVE)	Notes (Feelings or impressions about what was done or said)
(This section should contain only the account of what is actually observed or said. No judgments or evaluations should be listed in this side of the observational record.)	(This section should contain the observer's interpretation of what was seen and/or heard.)

SITE: ______________________
TEACHER: ____________________
CLASS: ______________________
REVIEWER: ___________________
DATE: _______________________

Document/Record Title: ____________________________________
____

CODE	INFORMATION

Organizing Data

The case study data must be stored in a format that makes it easily retrievable. The coding system should be one which (1) has the data easily available for analysis, (2) is the least time consuming, (3) is easy to implement, and (4) is cost effective.

The coding system should be designed so that each piece of data will be classified. A scheme needs to be established for identifying the school, the evaluator collecting the information at the site, the type of person (teacher, etc.) being interviewed or observed, the kind of document/record reviewed, and the data collection procedure (interview, observation, etc.). Each interview, observation, or document/record reviewed should be assigned a sequential number.

Each bit of information should be recorded on a separate index card or be retrievable from a computer. These small pieces of data can then be shuffled around in order to look at the information from different perspectives and to detect emerging themes.

Staff Training

It is crucial that a training session be conducted for all staff to be involved in the case studies. The first step to designing staff training is to identify the needs of the staff. The following questions might be used to identify and prioritize staff training needs.

STAFF TRAINING NEEDS

Rank Order	Should staff training include:	yes	no
b_______	1) Background information on the purpose of the case study?	☐	☐
_______	2) Clear definitions of terms and concepts to be used?	☐	☐
_______	3) Discussion of what to do before entering the site?	☐	☐
_______	4) Discussion of what to do when on site?	☐	☐

________	5)	Procedures to be used for the case study?	☐	☐
________	6)	An explanation of the coding system?	☐	☐
________	7)	Discussion/review of interview, observation, and document/record review methods?	☐	☐
________	8)	Practice with interview, observation, and document/record review methods through structured activities (e.g., role playing)?	☐	☐
________	9)	Practices with interview, observation, and document/record reviews in the field?	☐	☐
________	10)	Practice using the coding system?	☐	☐
________	11)	Opportunity to modify		
		a) case study procedures?	☐	☐
		b) coding system?	☐	☐
		c) persons to be interviewed?	☐	☐
________	12)	________________________________	☐	☐
________	13)	________________________________	☐	☐
________	14)	________________________________	☐	☐

A staff training session will probably cover a minimum of 3 days. Following is a sample staff training agenda.

SAMPLE STAFF TRAINING AGENDA

DAY 1

AM:
- Background and purpose of case studies
- Review of site selection process
- Review of schedule and work assignments
- Discussion of logistics
- Discussion of topics and subtopics
- Discussion of coding system, including coding exercise

PM: Interviewing procedures and techniques
Practice interviewing (role playing)
Observation procedures and techniques
Practice observing (role playing)
Reviewing documents and records
Exercise on document/record review
Using extant data

DAY 2

AM: Practice interviewing, observing, and document/record reviews at sample site

PM: Write up field notes and code information

DAY 3

AM: Evaluate field activity
Conduct data analysis to detect emerging trends, issues, problems

PM: Review procedures and revise, if needed
Review of assignments

Logistics of Fieldwork Operations and Data Collection

Following is a potpourri of do's and don'ts as one gets ready to enter the field.

Scheduling. Interviews and observations should be scheduled well in advance of site visit. If this is accomplished by telephone there should be a follow-up confirming letter. Daily schedules should be developed, remembering that at least as much time is needed to write up notes and code information as is needed to collect it.

Selecting interviewees, observations, and document/records. Selection should be made by the evaluators. Site personnel may make suggestions, but the final decisions should be made by the evaluators.

Recording responses. Decisions should be made about whether written notes or tape recording is required.

Participation. The primary concern is to collect data. The amount of participation should be such that the evaluator fits comfortably into the setting without disturbing or interfering with normal operations.

When in Rome . . . . Learn the language or jargon used at the site. This is essential if the evaluator is to be able to pick up on insights and clues as to how people at the site view and define situations, events, and things.

Interviewing suggestions. The following suggestions are made for conducting the interviews:

- Use an open-ended interviewing technique. To the extent possible, let the interviewee introduce what he/she considers relevant. The interviewer should set the context and then conduct the interview as a dialogue, not a question-by-question process of acquiring information from the interviewee.

- Establish a context for interviewing.
  - Secure a private room for the interview.
  - Assure confidentiality.
  - Try to avoid group interviews.
  - Be ready when the interviewee enters room. Have note pad, pens, recorder, handouts ready.
  - Set a tone that conveys the importance of the interview.
  - Keep the interview within prearranged time frame.

- Use successful interviewing techniques.
  - Be a good listener
  - Pursue in detail: seek examples and illustrations.
  - Take notes rapidly.
  - Be attentive.
  - Seek clarification.
  - Keep questions brief.
  - Begin interview with simpler questions.
  - Do not breach confidentiality.

- Potential Probes
  - Pause
  - Repetition of question or part of question
  - "What do you mean?" or "How do you mean?"
  - "Would you tell me more about your thinking on that?"
  - "What do you think?" or "What do you expect?"
  - "Which would be closer to the way you feel?" or "Which would be closer?"
  - "Are there any other reasons why you feel that way?"

- Neutral Prefaces
    - "Of course no one knows for sure . . ."
    - "Of course there are no right or wrong answers . . ."
    - "Of course there are no right or wrong answers; we're interested in people's opinions . . ."
    - "We're just interested in what you think . . ."
    - "We all hope, but . . ."
    - "Let me repeat the question . . ."
    - "Well, in general . . ."
    - "Generally speaking . . ."
    - "Overall . . ."
    - "In the Principles of Technology project as a whole..."
    - "Yes, but . . ."

- Carefully record data.
    - Take extensive notes and/or record interview.
    - Expand and complete notes as soon as interview is completed.
    - Code notes.
    - Type and edit notes.

Observations suggestions. The following suggestions are made for conducting the classroom observations:

- The observations should be of a nonparticipatory nature. The teacher and students should be aware that they are being observed, but the observer should not become a member of the group in the sense that he/she has a stake in the group outcomes.

- Observation involves inspection and contemplation of what one sees and hears. This necessitates an understanding of the context in which the Principles of Technology class operates and a recognition of the emotions and feelings shaping what one sees and hears.

- Extensive notes should be taken during the observation period.

- Following the observations, the notes should be expanded and coded according to the topic and subtopic areas.

- Be especially aware that the rights and privacy of observees are not sacrificed.

Document/record review suggestions. The following suggestions are made for reviewing documents and records.

- Examples of records and documents that might be reviewed include audits, supervisory reports, classroom expenses, tests, test results, teacher and student evaluations of Principles of Technology units, letters, memoranda, newspaper articles, tapes of radio broadcasts about the class, editorials, teacher generated materials, and so forth.
- Documents and records frequently provide a valuable sense of the context in which a program or class operates. They should be reviewed prior to conducting observations and interviews.
- "What is said", "How it is said", and "When it is said" are important considerations in all data collection, including document and record review.
- The reviewer needs to be cognizant of data that are personal, private, or classified. Caution must be exercised so as not to create special ethical problems.

Analyzing Data

The evaluator in the field begins the data analysis process as soon as the first data are collected. The evaluator will be looking for recurrent themes and areas where a greater concentration of effort is required. As data are collected and simultaneously analyzed, the evaluator will find that inferences will be drawn and new questions raised, and themes will develop that will adjust the scope, focus, and schedule of interviews, observations, and document/record reviews accordingly. Throughout the data collection phase, the data are continuously triangulated through various sources, kinds of data, and so forth.

It is important that the data be analyzed while they are fresh and clear in the evaluator's mind. This process involves the evaluator reading through all of the data in order to become familiar with the information obtained. This reading of all of the information collected is essential to confirm patterns and themes that emerged as the data were being collected and to identify new patterns and themes.

Reporting the Findings

The individual(s) responsible for collecting the data at a given site should be responsible for writing the report for that site. The individual(s) who have been on-site will have a much better feel for the data and will be able to provide a better sense of reality. The report writer may find the following helpful:

REPORTING THE FINDINGS

Did I:		Yes	No
1)	Explain the background (e.g., purpose, limitations).	☐	☐
2)	Describe the site completely.	☐	☐
3)	Use accurate, detailed, descriptions of actions and behaviors.	☐	☐
4)	Report word-for-word statements where appropriate.	☐	☐
5)	Report whether interaction with informants was effective and whether informants were reliable.	☐	☐
6)	Has data been used from all possible sources (e.g., interviews, observations, record/document reviews, extant data, other)?	☐	☐
7)	Did evaluator's presence and/or actions create disruptive or unnatural conditions?	☐	☐
8)	Have evaluator's pre-formed opinions unduly influenced data interpretation?	☐	☐
9)	Do interpretations flow directly from the data?	☐	☐

Enhancing case study report utilization. Potential for utilization should be a concern throughout the design, implementation, and reporting of the case study. Some suggestions for enhancing the probability of using case study findings are:

- The people for whom the information is intended should be involved in the initial stages of the planning. It is essential that they be involved in clarifying what their information needs are.
- Develop summary reports oriented to the needs of specific audiences.
- Conduct meetings with potential users so that evaluators and potential users can interact about various aspects of the report.

APPENDIX E

SECOND-YEAR INSTRUMENTS USED BY AIT/CORD

Unit # ____

Principles of Technology Unit Evaluation
Student Questionnaire

Grade ____ **Sex** ____ **Student ID #** ____

PURPOSE

Your honest answers to the questions on this form will help improve this ***Principles of Technology*** unit for other students. Your responses to the following items are appreciated.

DIRECTIONS

Below are a list of statements. Please read each statement and answer whether you strongly agree, agree, disagree, or strongly disagree by checking the appropriate box. Place a check mark [√] in only one box for each statement.

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT OBJECTIVES				
For this unit:				
1. the objectives helped me understand what I was supposed to learn..........	☐	☐	☐	☐
2. I'm glad the objectives are printed in the written materials..........	☐	☐	☐	☐
3. I used the objectives to guide me through the material..........	☐	☐	☐	☐

General comments on Unit Objectives:

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT CONTENT				
The content of this unit:				
4. had too much information..........	☐	☐	☐	☐
5. gave examples helpful in understanding concepts..........	☐	☐	☐	☐
6. was too difficult for me to understand..........	☐	☐	☐	☐
7. will probably be useful in future jobs..........	☐	☐	☐	☐

General comments on Unit Content:

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT VIDEO				
The video programs for this unit:				
8. helped me to better understand the text material	☐	☐	☐	☐
9. were interesting	☐	☐	☐	☐
10. used easy to understand graphics	☐	☐	☐	☐
11. helped me to achieve the unit objectives	☐	☐	☐	☐
General Comments on Unit Video:				
UNIT TEXT				
The unit text materials:				
12. helped me to achieve the unit objectives	☐	☐	☐	☐
13. will be a useful reference after taking the course	☐	☐	☐	☐
14. used language difficult for me to understand	☐	☐	☐	☐
15. had enough examples to help me understand the important concepts	☐	☐	☐	☐
16. helped me to understand the unit concepts	☐	☐	☐	☐
General comments on Unit Text:				
LABORATORY ACTIVITIES				
The unit lab activities:				
17. helped me achieve the unit objectives	☐	☐	☐	☐
18. were difficult	☐	☐	☐	☐
19. time periods were not long enough to complete the work	☐	☐	☐	☐

	Strongly Agree	Agree	Disagree	Strongly Disagree
20. in general, I liked them...	[ ]	[ ]	[ ]	[ ]

General comments on Laboratory Activities:

UNIT DIFFICULTY

For this unit:

21. some of the things we were expected to learn were just too hard...	[ ]	[ ]	[ ]	[ ]
22. I had trouble reading the unit text materials....................	[ ]	[ ]	[ ]	[ ]

General comments on Unit Difficulty:

STUDENT SATISFACTION

For this unit:

23. I usually had a sense of satisfaction after leaving class each day...	[ ]	[ ]	[ ]	[ ]
24. I did not like coming to class....................................	[ ]	[ ]	[ ]	[ ]
25. I would recommend it to my friends............................	[ ]	[ ]	[ ]	[ ]

General comments on Student Satisfaction:

Unit # ____

Teacher # ____

Principles of Technology Unit Evaluation
Teacher Questionnaire

PURPOSE

The primary purpose of this questionnaire is to provide teacher information for facilitating improvement of the *Principles of Technology* curriculum. Specifically, this form is designed to assess the appropriateness of *Principles of Technology* unit objectives and the appropriateness of instructional activities, resources, curriculum content, and instructional planning needed to accomplish these objectives.

DIRECTIONS

Below are a list of statements. Please read each statement and indicate whether you strongly agree, agree, disagree, or strongly disagree by checking the appropriate box. Place a check mark [√] in only one box for each statement.

	Strongly Agree	Agree	Disagree	Strongly Disagree

UNIT OBJECTIVES

The unit objectives:

1. assist me in assessing student progress....................	☐	☐	☐	☐
2. don't reflect what the unit is designed to teach...........	☐	☐	☐	☐
3. help me determine what to teach............................	☐	☐	☐	☐
4. are presented in logical order................................	☐	☐	☐	☐

General comments on Objectives:

UNIT INSTRUCTIONAL ACTIVITIES

The unit instructional activities:

5. are related to unit objectives................................	☐	☐	☐	☐
6. are presented in the correct sequence......................	☐	☐	☐	☐
7. require a reading level that is too difficult for most students..	☐	☐	☐	☐

General comments on Instructional Activities:

19. Based on your experiences, do you think the 6-day plan, per sub-unit, of 50-minute class sessions is realistic for this unit?

[ ] Yes, definitely
[ ] Yes, probably
[ ] No, probably not
[ ] No, definitely not

20. Overall, did you feel comfortable teaching the materials in this unit?

[ ] Yes, very comfortable
[ ] Yes, sort of comfortable
[ ] No, not very comfortable
[ ] No, not at all comfortable

If no, please explain:

21. What, if anything, caused you the most problems in teaching this unit?

22. What did you like the most in teaching this unit?

General comments on Perceptions of Instructional Planning:

23. Did you teach this unit on consecutive days for 26 days?

[ ] Yes [ ] No

If no, what pattern did you use (for example, 3 days a week)?

24. How much time per class session did you devote to this unit?

[ ] 50 minutes or less
[ ] 51-60 minutes
[ ] 61-90 minutes
[ ] 91+ minutes

25. Did you combine any of the unit's classes into one session (for example, teach classes C1 and C2 in one session)?

[ ] Yes [ ] No

If yes, which classes did you combine?

	Strongly Agree	Agree	Disagree	Strongly Disagree
UNIT CONTENT				
The unit content:				
8. was too detailed...	☐	☐	☐	☐
9. was presented at the proper level of difficulty...........	☐	☐	☐	☐
10. contained examples that were helpful to students in their understanding of unit concepts.....................	☐	☐	☐	☐
11. contained enough examples...............................	☐	☐	☐	☐
12. provided enough summaries of important points........	☐	☐	☐	☐
13. provided information that will be useful for students in their future employment.................................	☐	☐	☐	☐

General comments on Unit Content:

PERCEPTIONS OF INSTRUCTIONAL PLANNING

14. On average, how many hours did you spend preparing to teach each lesson in this unit? _____

15. Approximately how much time, on average, did you expect students to spend on homework each day for this unit?

☐ None
☐ About 15 minutes
☐ About half an hour
☐ About one hour
☐ Two hours or more

16. What percentage of students typically completed your homework assignments for this unit?

☐ Fewer than 25%
☐ 26-49%
☐ 50-74%
☐ 75% and above

17. What percentage of students typically completed your homework assignments for other courses that you teach?

☐ Fewer than 25%
☐ 26-49%
☐ 50-74%
☐ 75% and above

18. Do you feel the Teacher's Guide material provided you with enough information to help you teach the unit?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not

If not, what should be added to the guide to make it more useful?

26. Were there any special circumstances which, in your opinion, may have influenced the pre-or posttest scores? (e.g. lack of time; faulty lab equipment; school holidays; fire drill in the middle of the exam)

General Comments:

Unit # ____

Teacher ID # ____

Principles of Technology
Unit Daily Log

PURPOSE

The purpose of the Unit Daily Log is to provide a regular source of teacher information for improving the *Principles of Technology* curriculum.

DIRECTIONS

The left column on the following charts lists each activity for this particular unit. Since there are no materials specifically for the sub-unit review classes, these classes have not been listed in the chart.

For columns 1-5 on the attached charts:

1. Circle "Y" (yes) or "N" (no): Were the readings, labs, or videos appropriate (e.g., grade level, sufficient quantity of material) for your students? If not, specify modifications in column 5.
2. Circle "Y" (yes) or "N" (no): Were you able to cover the content in the 50-minute time period?
3. Briefly describe any errors or inaccuracies in the material.
4. Briefly describe any problems you had in managing the material. Among others, this may include problems in coordinating lab rotations, lab set-up, and maintaining student interest.
5. Briefly list suggestions for modifying the material. Describe "teaching tips" for future teachers.

We recommend that you take a few minutes each day to complete the charts. If you need more space for comments, use the back of the charts and/or attach additional pages.

Unit	[1] Appropriate for students?		[2] Completed in 50-60 minutes?		[3] Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	[4] Did you have any management problems? If so, please specify in the appropriate spaces below.	[5] Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
OVERVIEW							
Video	Y	N					
C0	Y	N	Y	N			
WAVE CHARACTERISTICS							
Video	Y	N					
C1	Y	N	Y	N			
C2	Y	N	Y	N			
Math Lab	Y	N	Y	N			
Lab 9-1	Y	N	Y	N			
Lab 9-2	Y	N	Y	N			

Unit	[1] Appropriate for students?	[2] Completed in 50-60 minutes?	[3] Did you discover any errors or inaccuracies? If so, please specify in the appropriate spaces below.	[4] Did you have any management problems? If so, please specify in the appropriate spaces below.	[5] Do you have any suggested modifications or general comments? If so, please specify in the appropriate spaces below.
WAVE APPLICATIONS					
Video	Y N				
C1	Y N	Y N			
C2	Y N	Y N			
Math Lab	Y N	Y N			
Lab 9-3	Y N	Y N			
Lab 9-4	Y N	Y N			
Summary					
Video	Y N				

APPENDIX F

ASSESSMENT INTERVIEW GUIDE

SUGGESTED AUDIT INTERVIEW QUESTIONS

Key:

SQ= Student Questionnaire
TQ= Teacher Questionnaire
UDL= Unit Daily Log
I= Interviews
CO= Classroom Observations
DR= Document Reviews

S= Student Interview
T= Teacher Interview
SA= School Administrator Interview
AIT= Agency for Instructional Technology Representative view

Code:

U= Utility
F= Feasibility
P= Propriety
A= Accuracy
DI= Developer Implementation
Example: U.2= Clarity of Information
F.1= Practical Procedures
P.3= Balanced Reporting

UTILITY (U)

1. Information Scope and Selection (T.AIT)

   A. To what extent did the SQ, TQ, UDL, I, CO, DR address the information needs of the curriculum developers?

   B. Was the information collected by the SQ, TQ, UDL, I, CO, DR sufficient to support a judgment of merit or worth? If so, to what extent? If not, what were the shortcomings?

   C. To what extent was the information collected by the SQ, TQ, UDL, I CO, DR useful? To what extent was the information collected redundant or meaningless?

   D. To what extent were the formative evaluation questions answered by the information collected from the six data collection activities?

2. Clarity of Information (AIT)

   A. To what extent was the information collected by SQ, TQ, UDL, I, CO, DR understandable to the curriculum developers?

   B. To what extent did the information collected by SQ, TQ, UDL, I, CO, DR respond clearly and without generalities to the formative evaluation objectives?

C. To what extent did the information collected by SQ, TQ, UDL, I, CO, DR provide a firm foundation for formative evaluation conclusions and recommendations?

D. To what extent was the information collected by the six data collection activities characterized by conciseness and logical development?

E. In sum, how well did the information collected by the six data collection activities communicate to the formative evaluation audiences?

3. Timeliness (AIT)

A. To what extent was the information collected by SQ, TQ, UDL, I, CO, DR, received by the curriculum developers on scheduled timeline dates?

B. How many curriculum revisions were delayed as a result of late formative evaluation information collected by SQ, TQ, UDL, I, CO, DR? What were the causes of these delays?

C. In sum, to what extent were the curriculum developer's most critical information needs met on time?

FEASIBILITY (F)

1. Practical Procedures (T, A, AIT)

A. To what extent were the SQ, TQ, UDL, I, CO, DR suggestions made by National Center staff for strengthening the formative evaluation realistic given time and financial constraints inherent in the formative evaluation project?

B. Were the SQ, TQ, UDL, I, CO, Dr evaluation procedures a practical approach to the formative evaluation of the Principles of Technology curriculum? To what extent were school and classroom disruptions minimized?

2. Political Viability (AIT)

A. To what extent were the evaluation procedures politically viable given the various interest groups and stakeholders of the Principles of Technology curriculum project?

B. Did any political conflicts erupt over the evaluation effort? If so, how were these conflicts handled? What impact did these conflicts have on achieving the purpose of the evaluation?

3. Cost Effectiveness (AIT)

   A. To what extent did the evaluation procedure information of sufficient value to justify the expense of the evaluation?

   B. Were there alternative evaluation approaches that would produce more useful information at the same or less cost? If so, please describe.

   C. Was the second year evaluation effort begun without a commitment of sufficient resources to ensure completion? If so, what data collection activities had to be compromised?

   D. For the information needed, to what extent was the evaluation conducted as economically as possible?

PROPRIETY (P)

1. Rights of Human Subjects (S, T, A, AIT)

   A. To what extent were the rights and welfare of the participants who participated in the evaluation respected and protected?

   B. To what extent were legal, ethical, and common sense considerations followed?

2. Conflicts of Interests (T, A, AIT)

   A. To what extent were conflicts of interest in the evaluation effort avoided? If conflicts of interest arose, how were they dealt with so that the evaluation process and results were not compromised?

3. Balanced Reporting (AIT)

   A. To what extent was the evaluation complete and fair in its presentation of strengths and weaknesses? Were both negative and positive aspects of the curriculum evaluation reported? Give examples.

   B. To what extent were evaluation findings that might prove embarrassing to partisan interest groups omitted from formative evaluation findings? In other words, what strengths and weaknesses were manipulated to please partisan interest groups?

ACCURACY (AC)

1. Clearly Identified Object (AIT)

   A. To what extent was the object of the formative evaluation clearly identified?

   B. Given project constraints, to what extent was the object of the evaluation described realistically?

2. Purposes and Procedures Explicated (S, T, A, AIT)

   A. To what extent were the purposes and procedures of the formative evaluation understood by you?

   B. Were you clear on the objectives of the evaluation?

   C. To what extent were procedures on how information was collected, organized, analyzed, and reported clearly delineated?

   D. If the evaluation were to be replicated, were purposes and procedures described in sufficient detail so that other evaluators could conduct a similar evaluation in other settings. If not, what do you suggest for ~~im~~proving the purposes and procedures?

DEVELOPER IMPLEMENTATION (DI)

1. Preparation (S, T, A, AIT)

   A. To what extent were you (S, T, A, AIT) prepared for the formative evaluation?

   B. To what extent were you (teachers) prepared to implement the evaluation instruments?

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